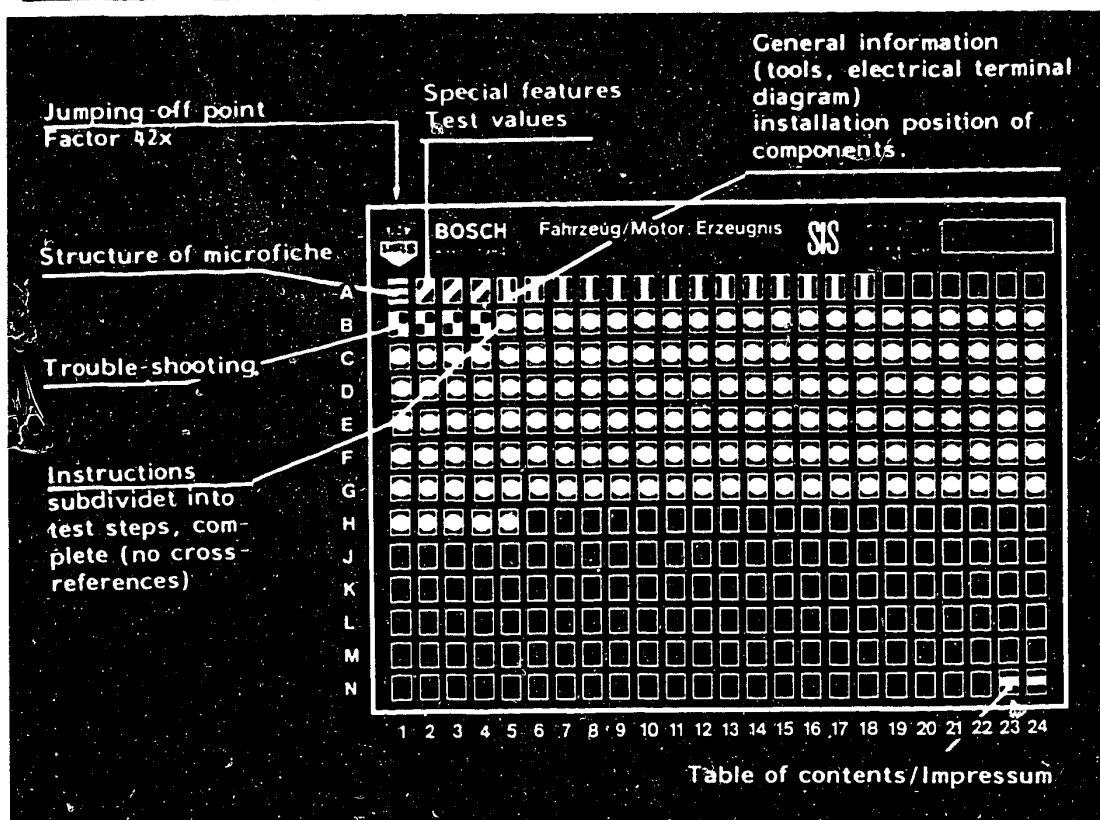


## Structure of microfiche

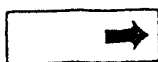


1. Read from left to right
2. Title of microfiche (appears on each coordinate)

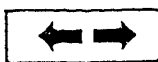
<b>E16</b>	Product/component/test step
	Vehicle/engine

Coordinate

3. Limits of section



Beginning



Mid-section



End



One-page section

4. Purely vehicle-specific passages in the text are marked with a vertical bar.

5. Reference to relevant working steps in the test specifications, e.g. coordinate C6.

**C6**

**A1**

Trouble-shooting program



## 1. Special features

This microfiche card covers the following vehicle models with 6-cylinder diesel engines:

Volvo 240 D (after 4.79)

Volvo 760 turbo-diesel (after 8.82)

US and California models

With AFB (altitude-pressure compensation)

## 2. Test specifications

2.1 Idle speed:  $750 \pm 50 \text{ min}^{-1}$

**C12**

2.2 Nozzle opening pressure: 130 + 8 bar  
(D24)

**C23**

155 + 8 bar  
(D24 turbo)

2.3 Filter test  
max. allowable differential  
pressure: 0.3 bar

**C3**

**A2**

Test specifications

Volvo 240 D, 760 D-Turbo



2.4 Pressure drop: max. allowable  
25 %

**E1**

2.5 Injection timing:

Engine position: 1st cylinder at TDC

**G14**

Checking value:

Pump position: 0.65...0.75 mm ABDC (D24)

Pump position: 0.78...0.85 mm ABDC (D24 Turbo)

Setting values:

Pump position: 0.70 mm ABDC (D24)

Pump position: 0.80 mm ABDC (D24 Turbo)

2.6 Charge-air pressure 0.70...0.77 bar

2.7 Overpressure valve 0.80...0.85 bar

**A3**

Test specifications  
Volvo 240 D, 760 D-Turbo



## 2.8 Compression pressure

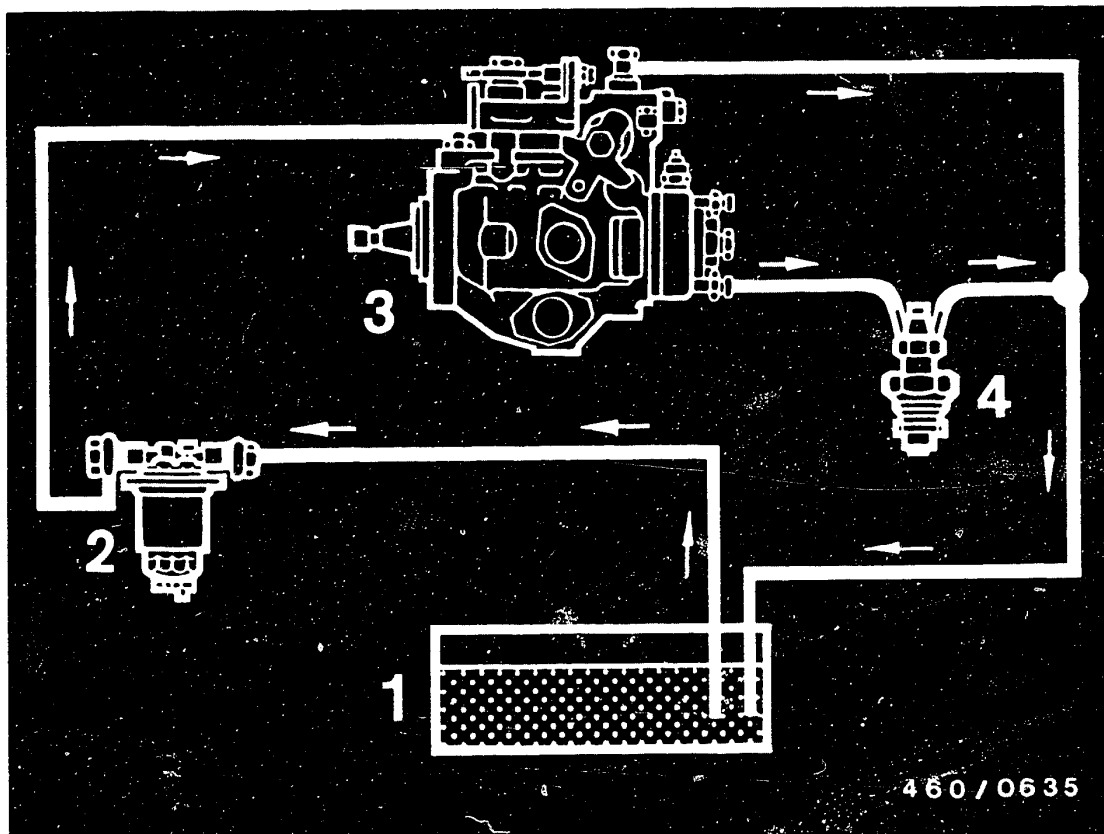
Engine type	Compression pressure	Allowable cylinder deviation
D24	28 ... 34 bar	max. 5 bar
D24 Turbo	24 ... 32 bar	max. 8 bar

## 2.9 Tightening torques

Fuel-injection pump gear	45 Nm
Fuel lines	25 Nm
Fastening screws for fuel-injection pump	25 Nm
Camshafts	45 Nm
Screw plug	15 Nm
Fastening screws for nozzle holder assembly	70 Nm
Sheathed-element glow plugs	40 Nm
Camshaft gear	100 Nm
Bleeder screw	15 Nm
Support bracket for fuel-injection pump	25 Nm
Fuel-injection pump console	65 Nm
Exhaust gas turbocharger-exhaust manifold	60 Nm
Muffler pipe - turbocharger	25 Nm







- 1 = Fuel tank
- 2 = Fuel filter
- 3 = Distributor-type fuel-injection pump
- 4 = Fuel injection nozzles

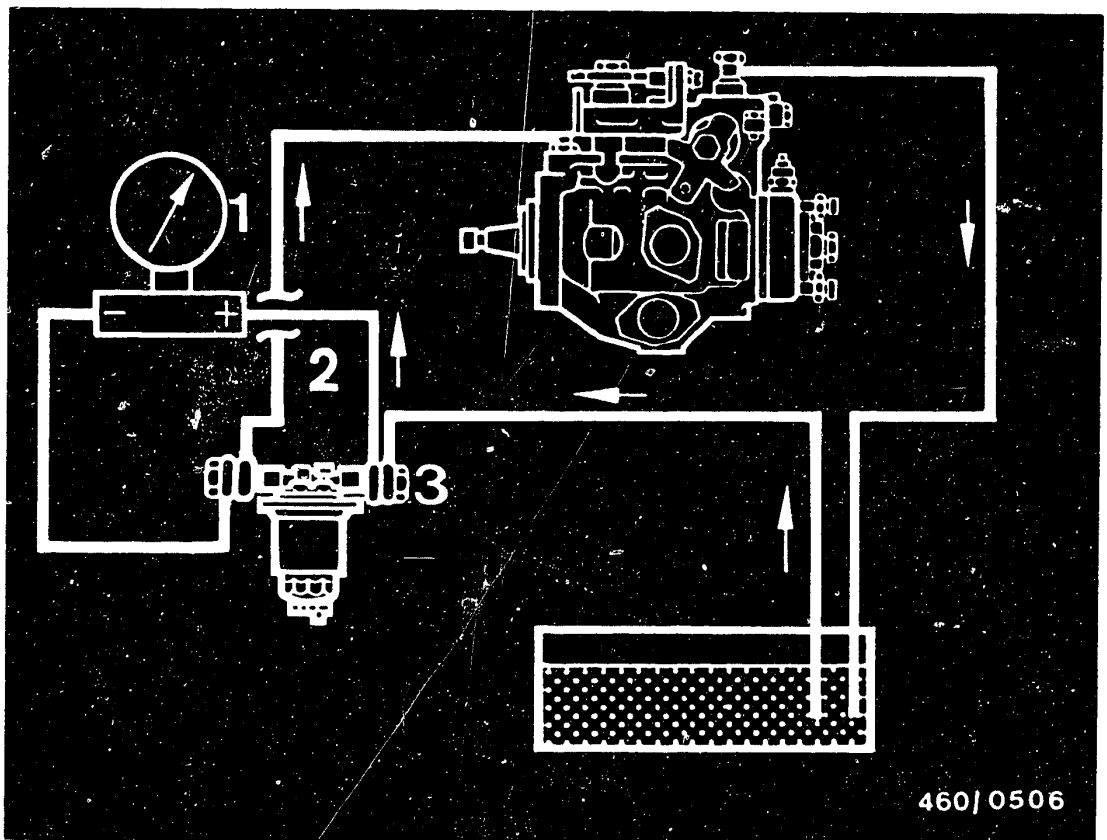
### 3. Diagrams of lines for induction and turbocharger engine

#### 3.1 Diagram of fuel lines

The fuel lines are connected as shown in the diagram above.

The fuel flows in the direction of the arrows.



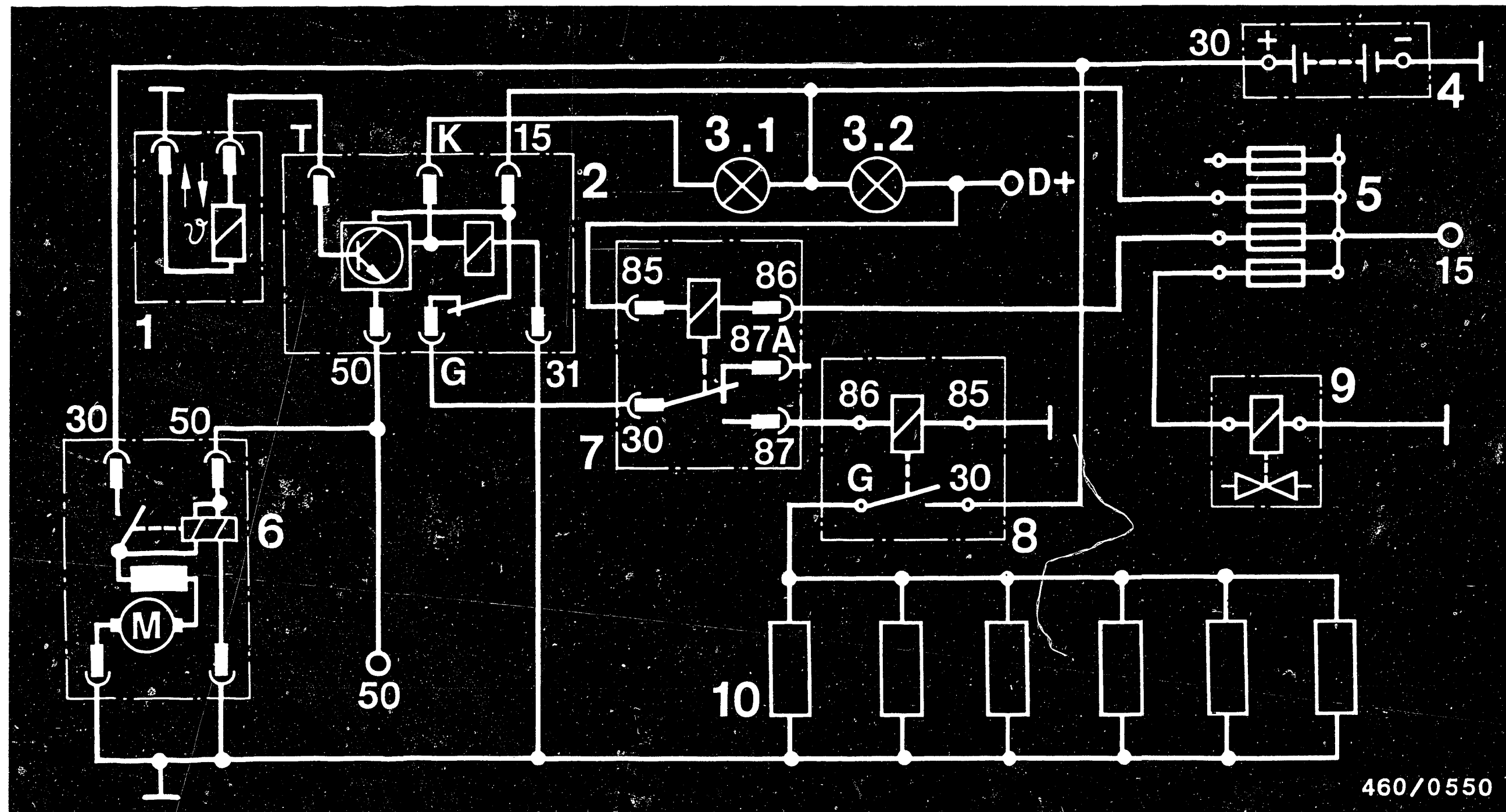


- 1 = Differential pressure gauge
- 2 = Filter drain  
(use inlet union and overlong inlet-union screw  
2 443 456 020)
- 3 = Filter inlet  
(use inlet union and overlong inlet-union screw  
2 443 456 020)

### 3.2 Diagram of connections for filter test

Connect the differential pressure gauge to the fuel filter across appropriate connecting parts.





460/0550

1 = Temperature sensor  
 2 = Glow duration controller  
 3.1 and 3.2 = Preheater control light

4 = Battery  
 5 = Fuse terminal board  
 6 = Starting motor

7 = Cutoff relay  
 8 = Circuit breaker  
 9 = Solenoid valve  
 10 = Glow plugs

4. Connection diagram for the preheating system Volvo 240 D (1979 - 1980)

The cutoff relay (7) is grounded across the control switch/generator when the generator is not charging.

**A7**

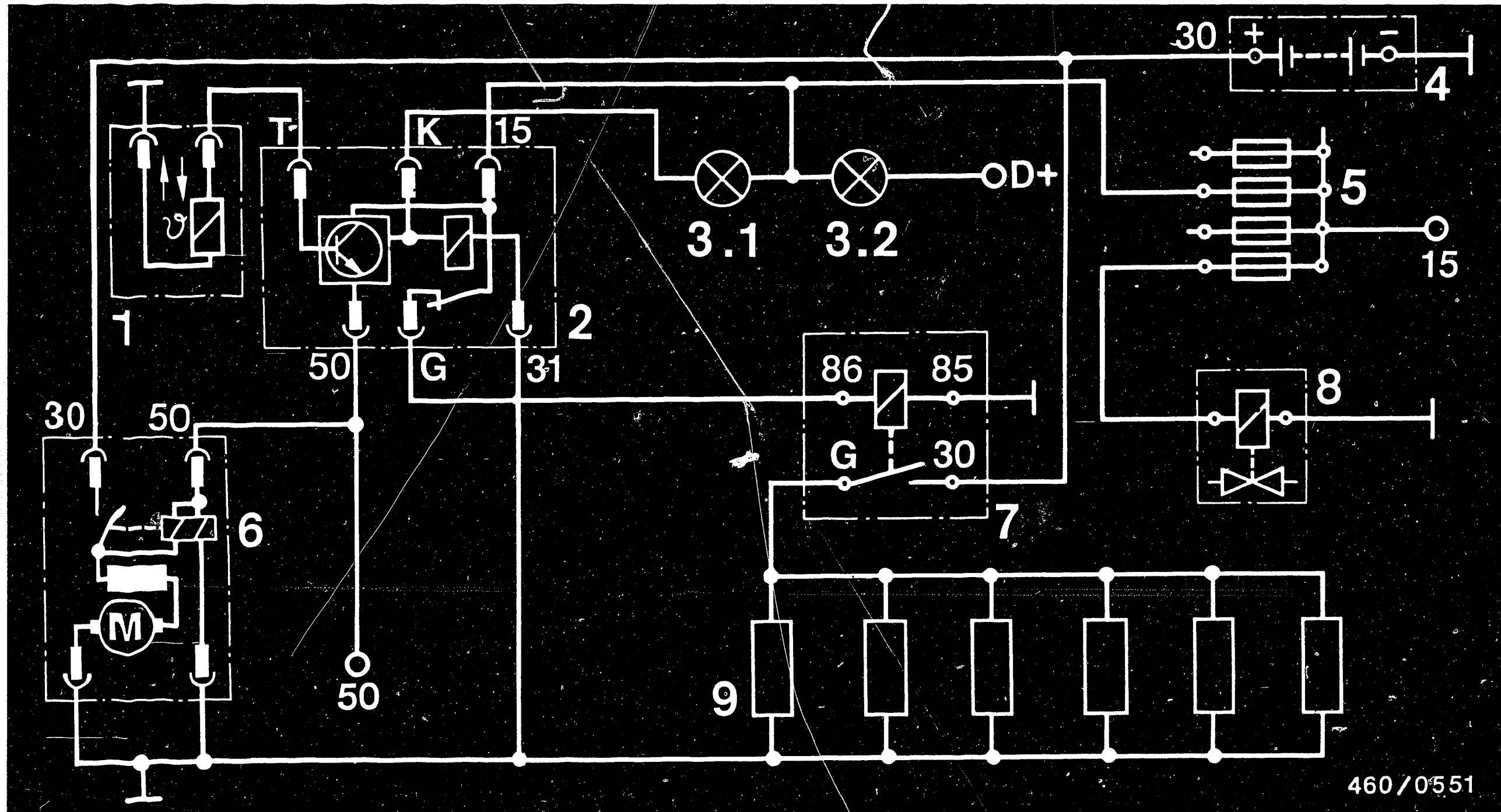
Connection diagram, preheater system  
 Volvo 240 D, 760 D-Turbo



**A8**

Connection diagram, preheater system  
 Volvo 240 D, 760 D-Turbo





1 = Temperature sensor  
 2 = Glow duration controller  
 3.1 and 3.2 = Preheater control light

4 = Battery  
 5 = Fuse terminal board  
 6 = Starting motor

7 = Cutoff relay  
 8 = Circuit breaker  
 9 = Glow plugs

Connection diagram for the preheating system, Volvo 240 D (after 1981)

**A9**

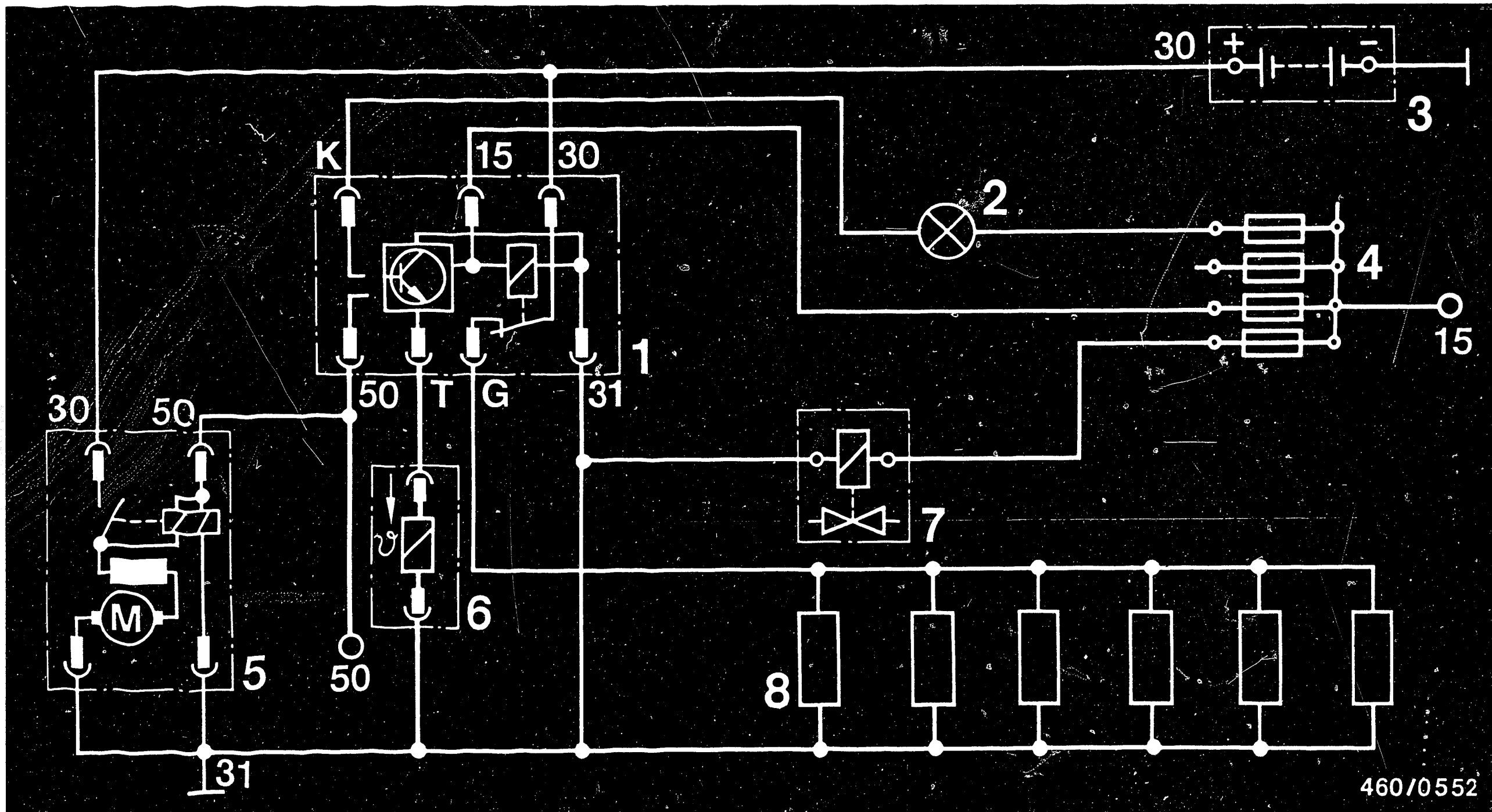
Connection diagram, preheater system  
 Volvo 240 D, 760 D-Turbo



**A10**

Connection diagram, preheater system  
 Volvo 240 D, 760 D-Turbo





1 = Glow duration controller  
2 = Preheater control light  
3 = Battery

4 = Fuse terminal board  
5 = Starting motor  
6 = Temperature sensor

7 = Solenoid valve  
8 = Glow plugs

Connection diagram for the preheater system (Volvo 760 D Turbo (after 8.82))

**A11**

Connection diagram, preheater system  
Volvo 240 D, 760 D-Turbo



**A12**

Connection diagram, preheater system  
Volvo 240 D, 760 D-Turbo



460/0552

## 5. Test equipment and tools

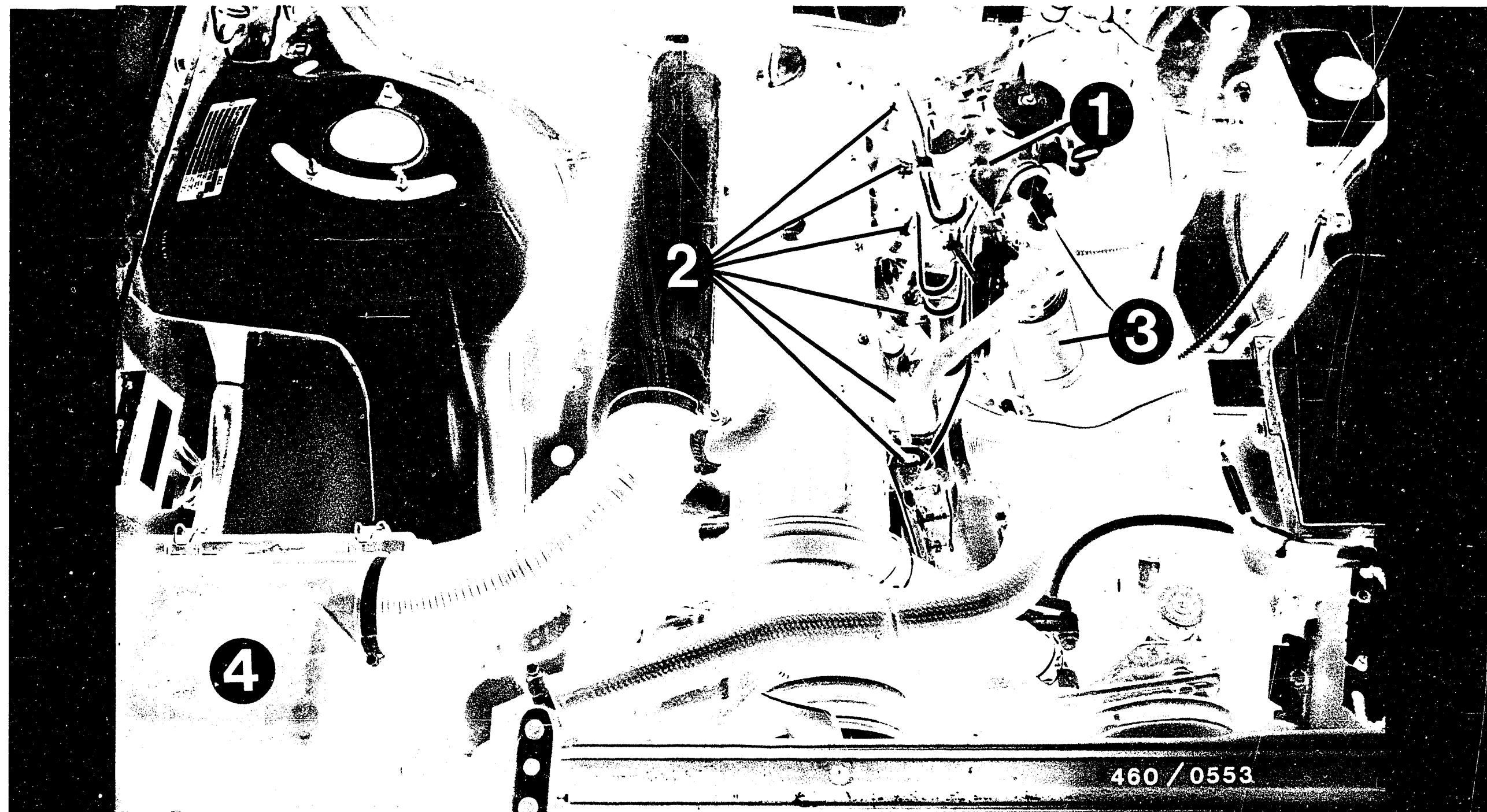
Designation	Part number	Use
Puller	KDEP 1119	Pull off fuel-injection pump gear
Locating mandrel	KDEP 1122	Locking fuel-injection pump gear in place
Holding tool	KDEP 1116	To hold the camshaft gear in place
Toothed belt tester	KDEP 1121	Testing the toothed belt tension
Adjusting straight edge	KDEP 1117	Fixing the camshaft in place
Box wrench	KDEP 1115	Releasing and tightening fuel-injection lines
Measuring tool	KDEP 1085	Injection timing
Mini dial indicator, graduation 1/100 mm	Commercially available e.g., Hahn & Kolb 7000 Stuttgart Part No.33 003 with adapter KDEP 1127	Injection timing
Box wrench	KDEP 1120	To tighten the camshaft gear
Pressure tester, or pressure gauge 0...1.6 bar	KDJE-P 100 e.g., Wika No. 4184	Checking charge-air pressure



## Test equipment and tools (continued)

Designation	Part number	Use
Nozzle tester	EFEP 60 H 0 681 200 502	Checking fuel-injection nozzles
Compression tester	Commercially available	Checking engine compression
Pressure drop tester	EFAW 210 A 0 681 001 901	Checking engine pressure drop
Tachometer	Commercially available	Adjusting engine speed
Differential pressure gauge	Commercially available Part No. NG 160/311-911/ -1.0 + 4.0 bar Firma Henni Nauheimer Str. 78 - 80 7000 Stuttgart 50	Filter test
Analyzer Accessory box with metering pump	0 684 102 050 0 681 169 038	Exhaust test





1 = Fuel-injection pump

2 = Fuel-injection nozzles

3 = Fuel filter

4 = Air filter

6. Installation position of the components, Volvo 240 D (after 4.79)

**A15**

Installation position of the components  
Volvo 240 D, 760 D-Turbo

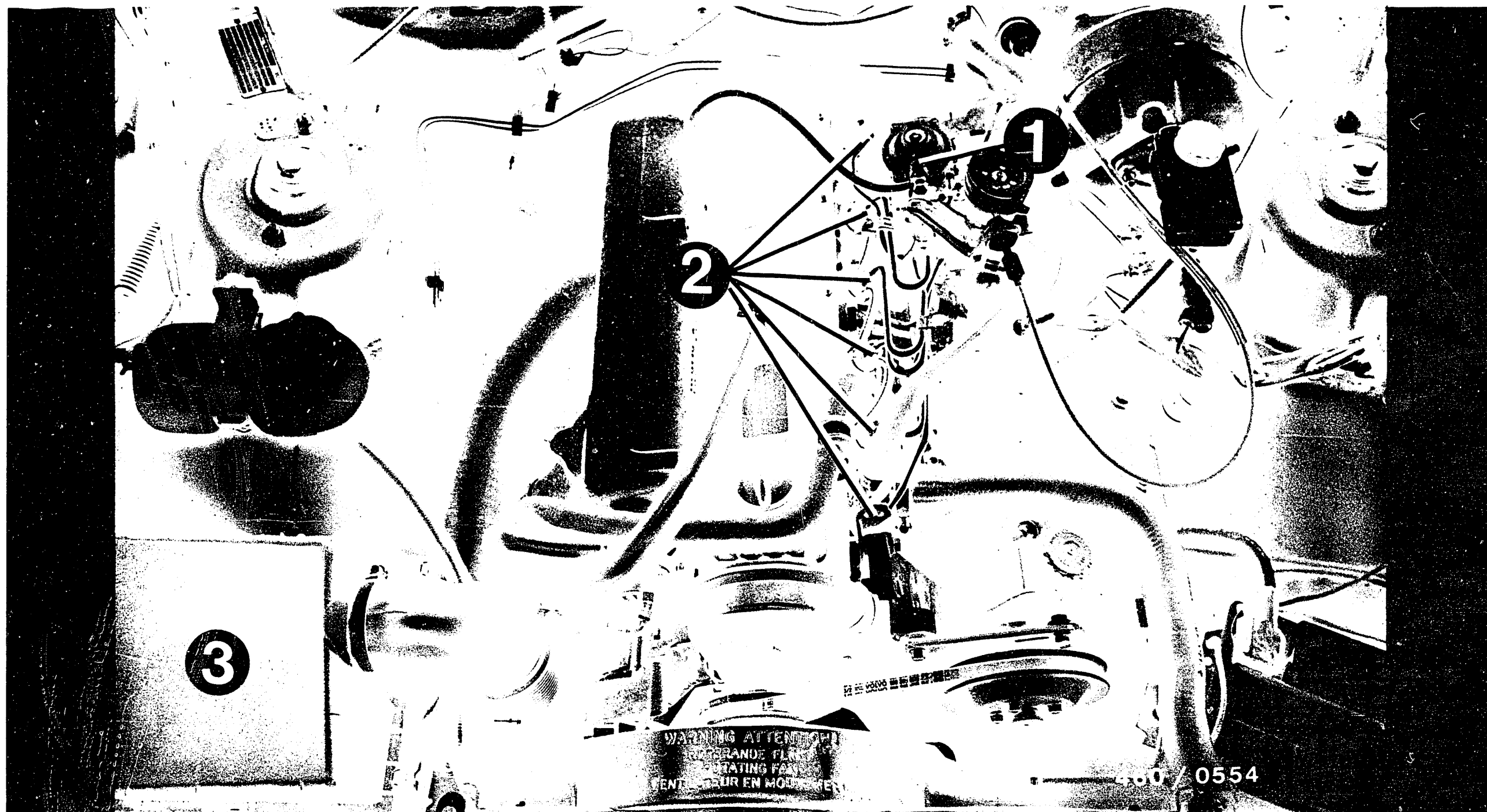


**A16**

Installation position of the components  
Volvo 240 D, 760 D-Turbo







1 = Fuel-injection pump

2 = Fuel-injection nozzles

3 = Air filter

Installation position of the components, Volvo 760 Turbo (after 8.82)

**A17**

Installation position of the components  
Volvo 240 D, 760 D-Turbo



**A18**

Installation position of the components  
Volvo 240 D, 760 D-Turbo



Customer complaint (fault symptom)

Customer complaint (fault symptom)

6. Driving power not satisfactory

Cause (component defect)

Coordinates

●	●			●	●	Tank empty; tank ventilation clogged	B 5
	●					Cold starting accelerator not activated	B 6
	●		●			Injection sequence differs from ignition sequence (check how supply line is laid)	B 9
				●		Overflow throttle clogged	B 10
●	●					Shutoff device defective	B 11
		●		●	●	Inlet-union screws for the supply and return line clogged	B 15
●	●		●	●	●	Air in the fuel system	B 17
	●					Heavy paraffin precipitation in the filter	B 20
●	●			●	●	Loose connections; lines leaking or broken	B 23
●	●			●	●	Supply lines clogged	C 2
●	●			●	●	Fuel-injection lines clogged or restricted	C 2
					●	Engine air filter clogged	C 3
			●			Idle speed incorrect	C 12
●	●		●		●	Fuel-injection nozzle defective	C 23
	●		●		●	Engine timing	G 24
●	●			●	●	Fuel filter clogged	D 2
	●					Preheater system defective	D 5
					●	Timing device defective	D 23
	●		●			Engine compression poor or uneven	E 1
					●	Maximum engine speed incorrectly set (take out and replace fuel-injection pump)	E 12
●	●	●	●	●	●	Fuel-injection pump (control) defective or misadjusted (take out and replace fuel-in.pump)	E 12
					●	Check turbocharger for leaks and charge-air pressure	G 21

## Trouble-shooting



## Trouble-shooting

### Volvo 240 D, 760 D-Turbo



# Trouble-shooting (continued)

7. Poor mileage							
8. Engine cannot be shut off							
9. Engine runs hard, black exhaust gas in full-load range; possibly poor performance							
10. Fog-like exhaust gases in the full-load range (white)							
11. Incorrect engine speed							
12. Engine does not accelerate when cold							
13. Distributor-type fuel-injection pump becomes too hot							
						Cause (component defect)	Coordinates
			●		●	Tank empty; tank ventilation clogged	B 5
					●	Cold starting accelerator not activated	B 6
		●		●	●	Fuel-injection sequence differs from ignition sequence (check how supply line is laid)	B 9
					●	Overflow throttle clogged	B 10
	●					Shutoff device defective	B 11
			●	●	●	Inlet-union screws for the supply and return line clogged	B 15
			●		●	Air in the fuel system	B 17
					●	Heavy paraffin precipitation in the filter	B 20
●						Loose connections; lines leaking or broken	B 23
			●		●	Supply lines clogged	C 2
			●		●	Fuel-injection lines clogged or restricted	C 2
		●				Engine air filter clogged	C 3
				●		Idle speed incorrect	C 12
		●				Fuel-injection nozzle defective	C 23
●		●	●		●	Engine timing	G 24
			●		●	Fuel filter clogged	D 2
		●	●			Timing device/AFB defective	D 23/B 7
●					●	Engine compression poor or uneven	E 1
				●		Max.engine speed incorrectly set (take out and remove fuel-injection pump)	E 12
●	●	●	●	●	●	Fuel-injection pump (control) defective or incorrectly set (take out and replace)	E 12

B3

Trouble-shooting

Volvo 240 D, 760 D-Turbo

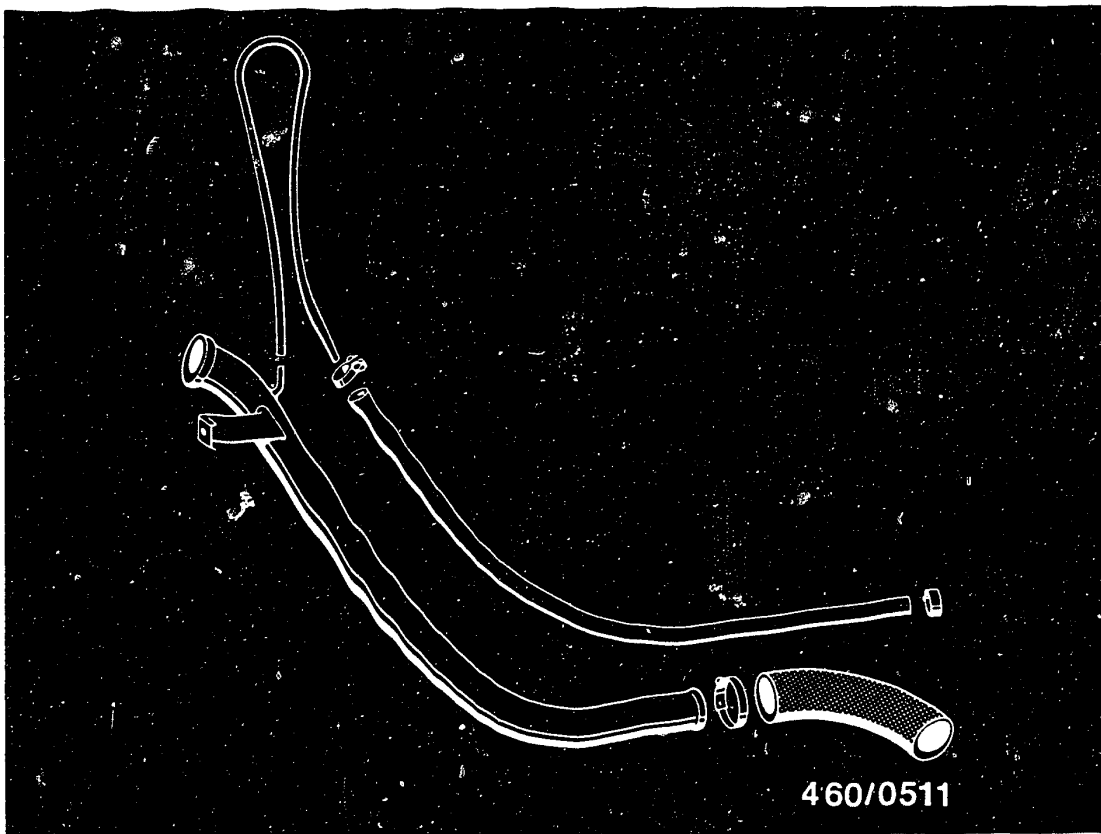


B4

Trouble-shooting

Volvo 240 D, 760 D-Turbo





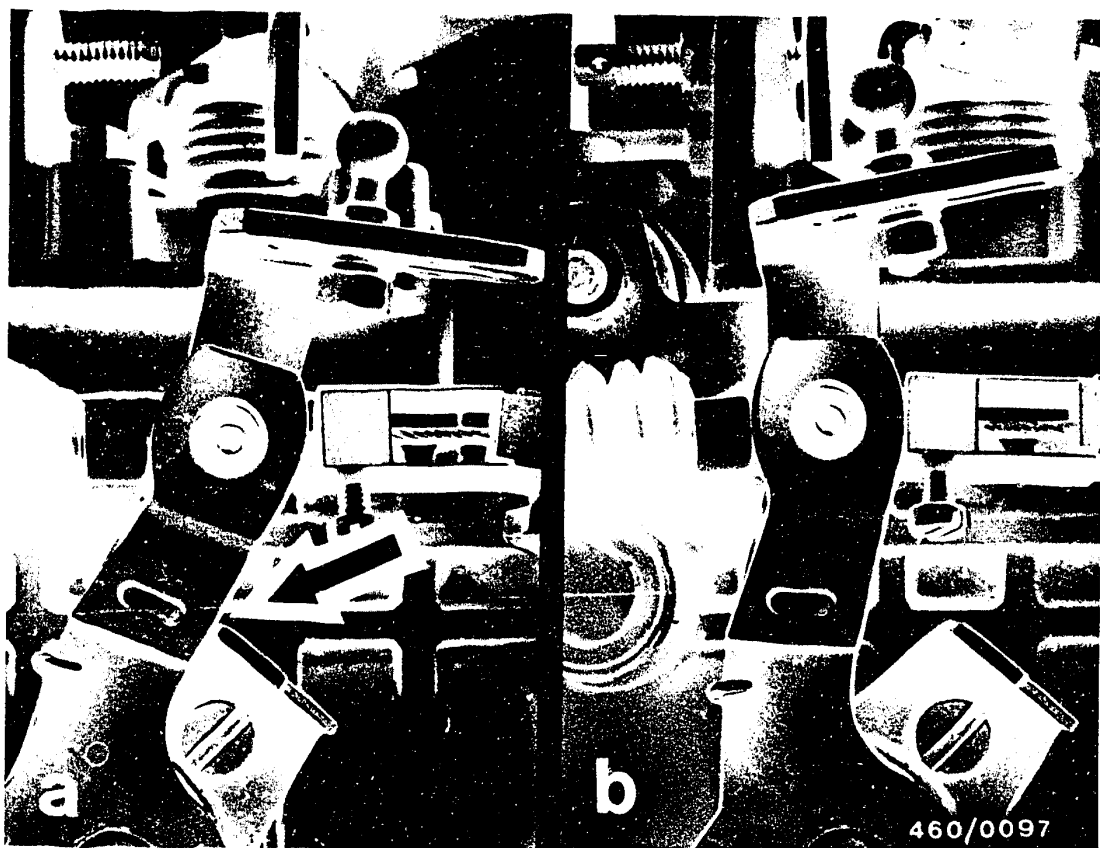
### 8. Checking tank ventilation

Open tank cover.

If the problem no longer occurs when the tank cover has been opened, the tank ventilation is defective.

Remove tank ventilation hose lines (figure) and check for clogging or restrictions.

If need be, check connecting pipe on the tank.



### 9. Checking the operation of the temperature-controlled cold-starting accelerator

When the cold-starting accelerator is correctly set, the control lever of the cold-starting accelerator must touch against the stop bracket (Fig. a - arrow) when the engine is at normal operating temperature (cooling water temperature approx.  $+80^{\circ}\text{C}$ ).

When the engine is cold, the control lever of the cold-starting accelerator has reached its maximum working stroke (Fig. b).

If the control lever sticks at the stop bracket when cold, or if it merely makes a small stroke, the fuel-injection pump must be taken out and readjusted.

10. Checking the AFB (start of delivery with altitude-pressure compensation)

At elevations less than 900 - 1200 m above sea level (877 - 910 mbar), there must be battery voltage present at connecting contacts 1 and 2 on the barometer box (figure at top).

Is there voltage here?

no

If contact 1 has no voltage, check lead to Term. 1 for a break. Eliminate any break.

no

If contact 2 has no voltage, take out and replace barometer box.

yes

Check the operation of the solenoid valve for the distributor-type fuel-injection pump (photo at bottom, arrow)

Is there voltage at the solenoid valve?

no

Check the lead between the barometer box Term. 2 and the solenoid valve for a break. Eliminate any break.

yes

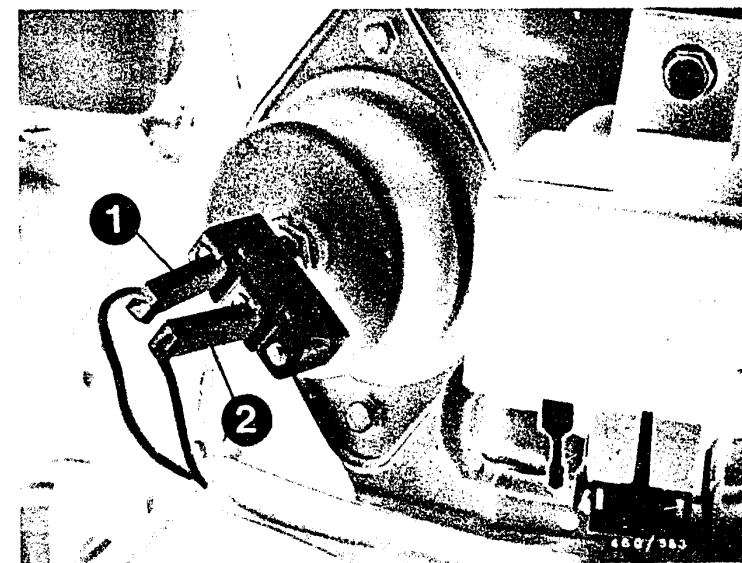
Disconnect lead at the solenoid valve. Run the engine up to an average speed. Does the engine run "harder" because of early adjusting?

no

Take out and replace solenoid valve.

yes

Altitude compensation device O.K.



**B7**

Checking AFB

Volvo 240 D, 760 D-Turbo

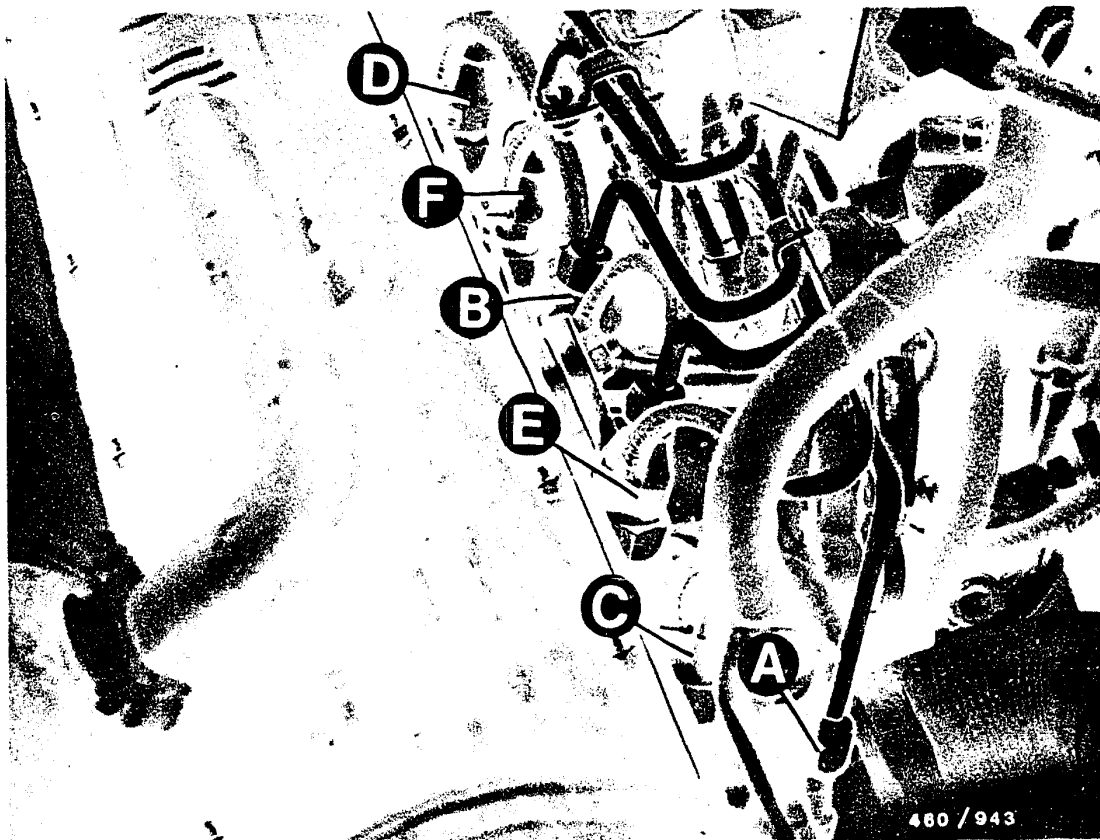


**B8**

Checking AFB

Volvo 240 D, 760 D-Turbo





### 11. Checking position of supply line

The supply lines are joined to one another using clamps so that mistaking outlets one for the other is not possible.

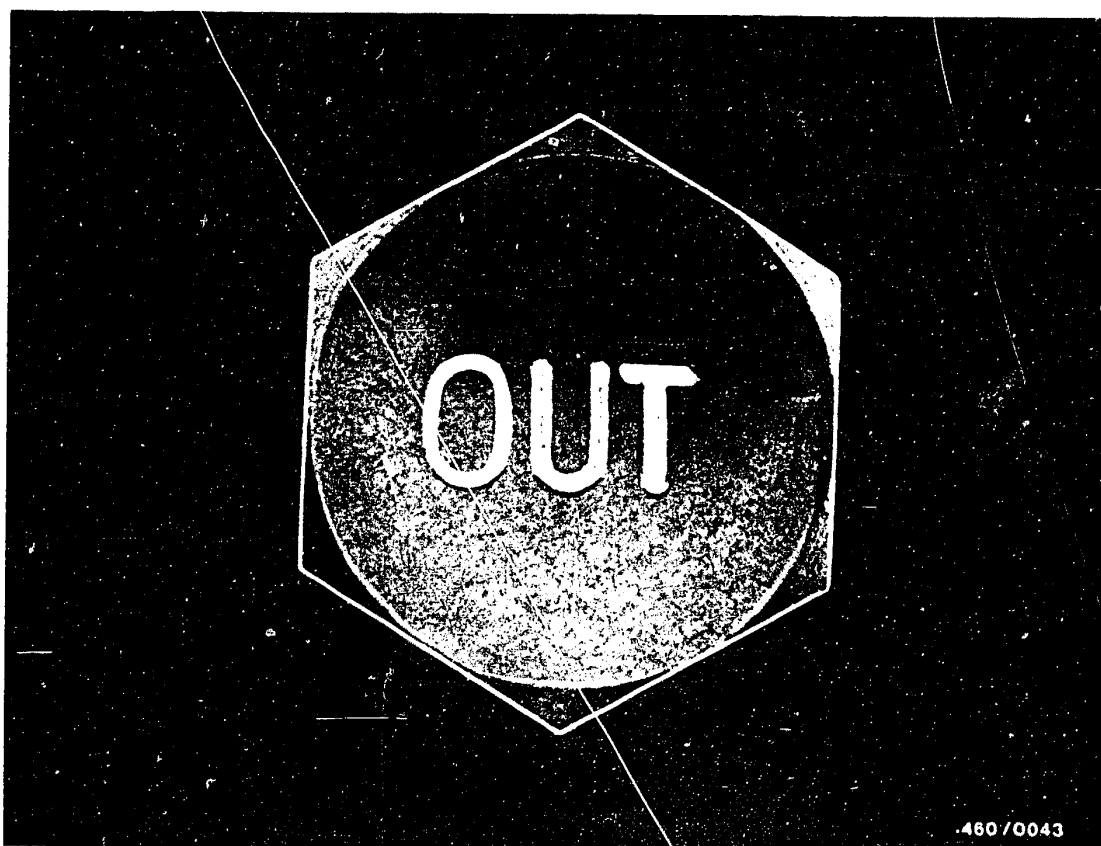
If there are points that are unclear even so, check the position of the lines against the figure at the top.

The correlation between the fuel-injection pump outlets and the individual engine cylinders has been identified using the letters A to F.

**B9**

Checking position of supply lines  
Volvo 240 D, 760 D-Turbo





## 12. Checking overflow throttle

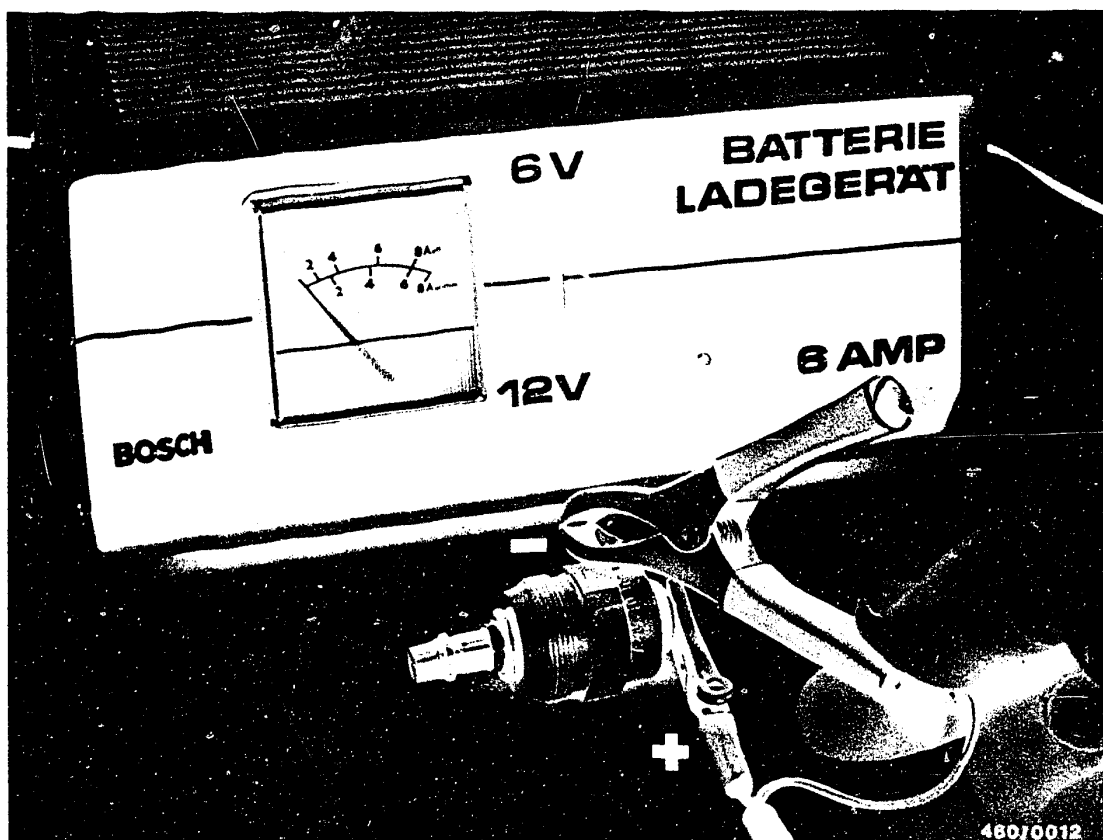
Unscrew the overflow throttle on the fuel-injection pump (identified with "OUT").

Check the built-in wire filter for dirt visually.

If there is any doubt, take out and replace the overflow throttle.







### 13. Checking the operation of the shutoff device

#### 13.1 Engine does not start

Check that the solenoid valve is supplied with voltage (min. 10 V) when the glow-plug and starter switch is turned on (drive position).

If there is voltage present, take off the fuel-injection lines and take out the solenoid valve.

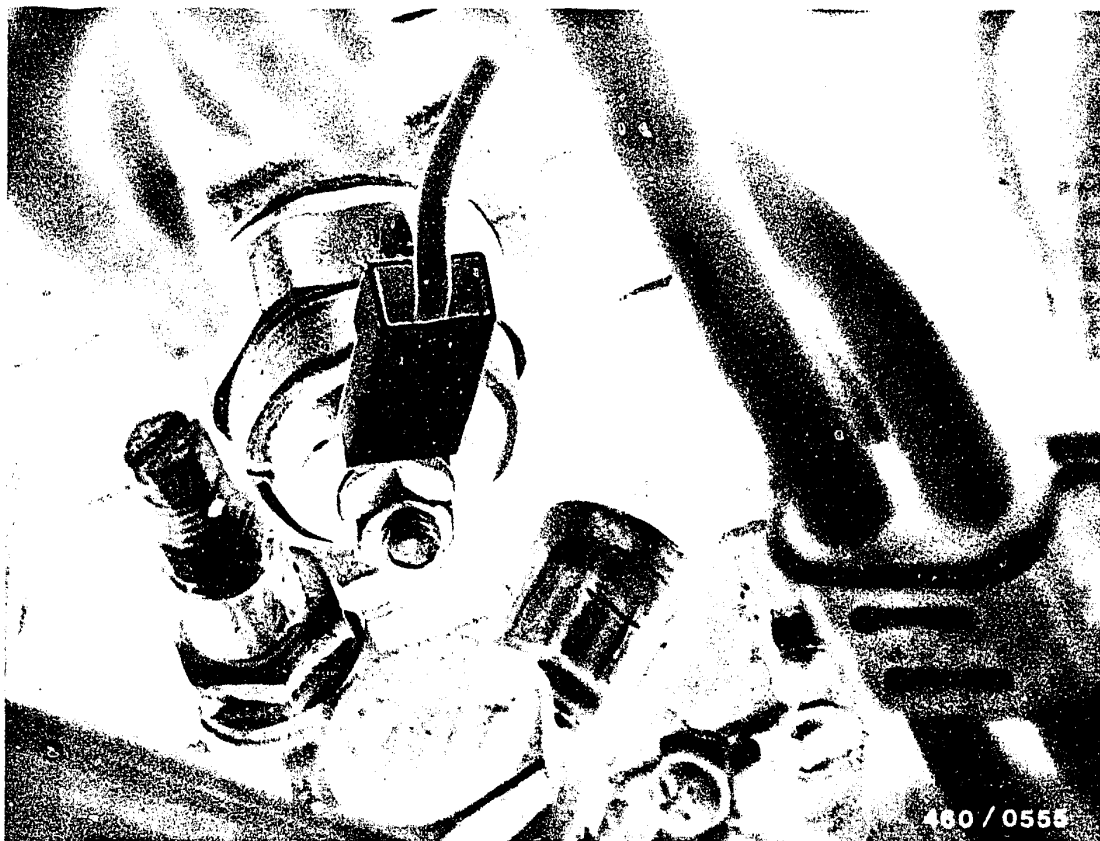
Be clean and neat in doing this!

When the solenoid valve has been taken out, check its operation.

Note:

It is permissible to supply voltage to the solenoid valve only for a brief time when it has been taken out, since there is no cooling effect due to fuel.





### 13.2 The engine cannot be shut off

There must not be any voltage present at the solenoid valve when the glow-plug and starter switch is in the stop position, i.e., the supply of fuel at the distributor piston is interrupted.

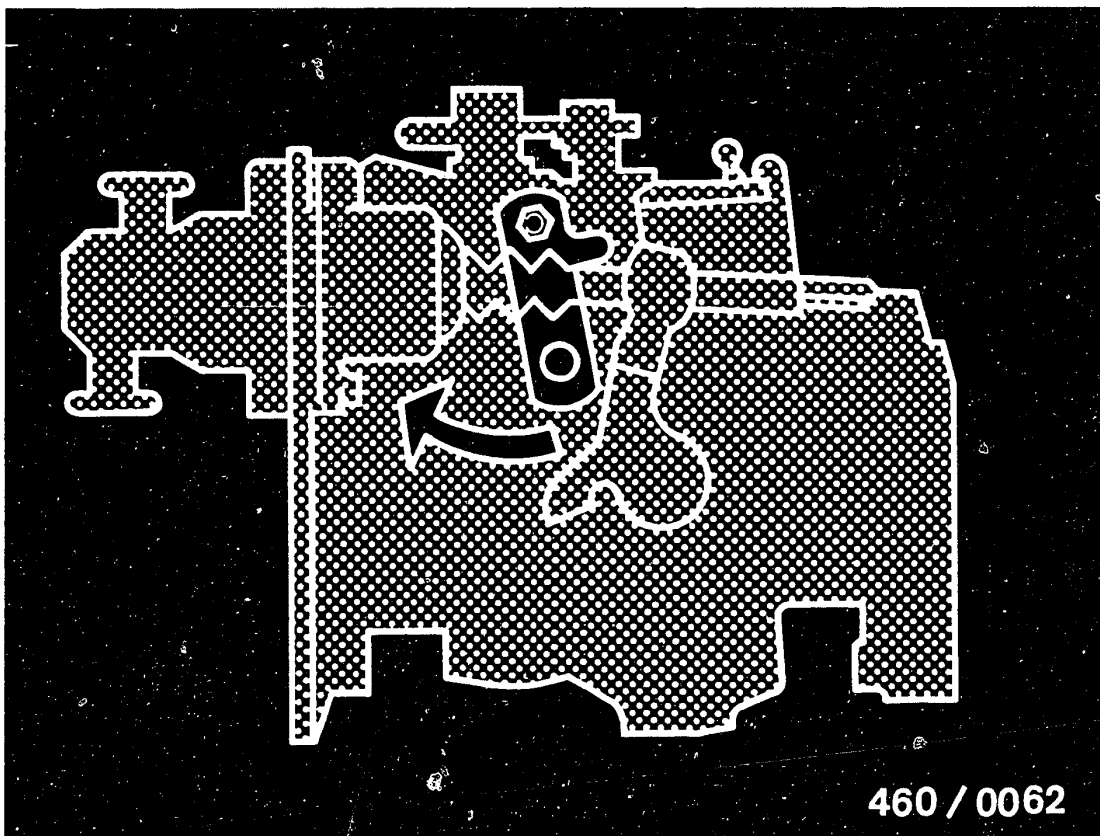
If the engine continues to run, even though there is no voltage present at the solenoid valve, the engine can be shut off as follows:

#### ● Manual-transmission vehicles

Put into 3rd or 4th gear.

Step firmly on the foot brake and allow the clutch pedal to return.





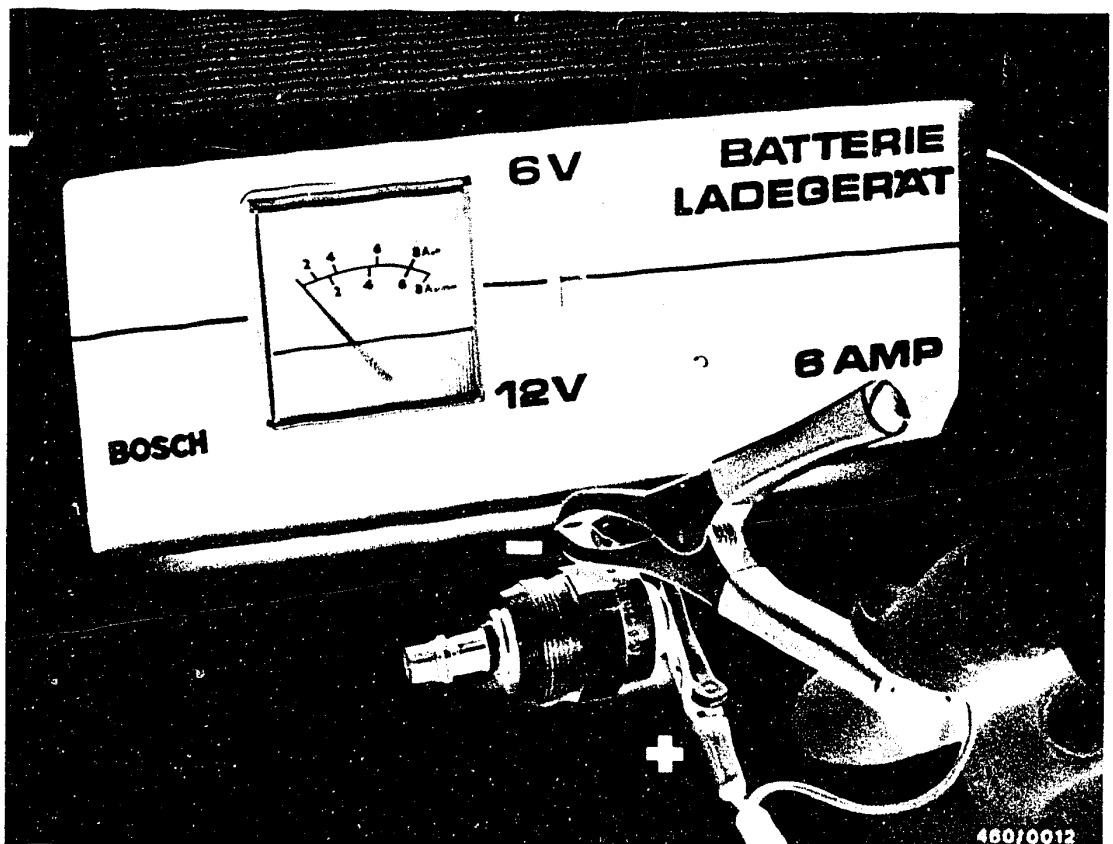
● Automatic transmission vehicles

Activate the emergency shutoff lever on the fuel-injection pump (figure).

**B 13**

Checking the shutoff device  
Volvo 240 D, 760 D-Turbo





### 13.3 Checking the solenoid valve

Remove the fuel-injection lines.

Take out the solenoid valve.

Be neat and clean in doing so!

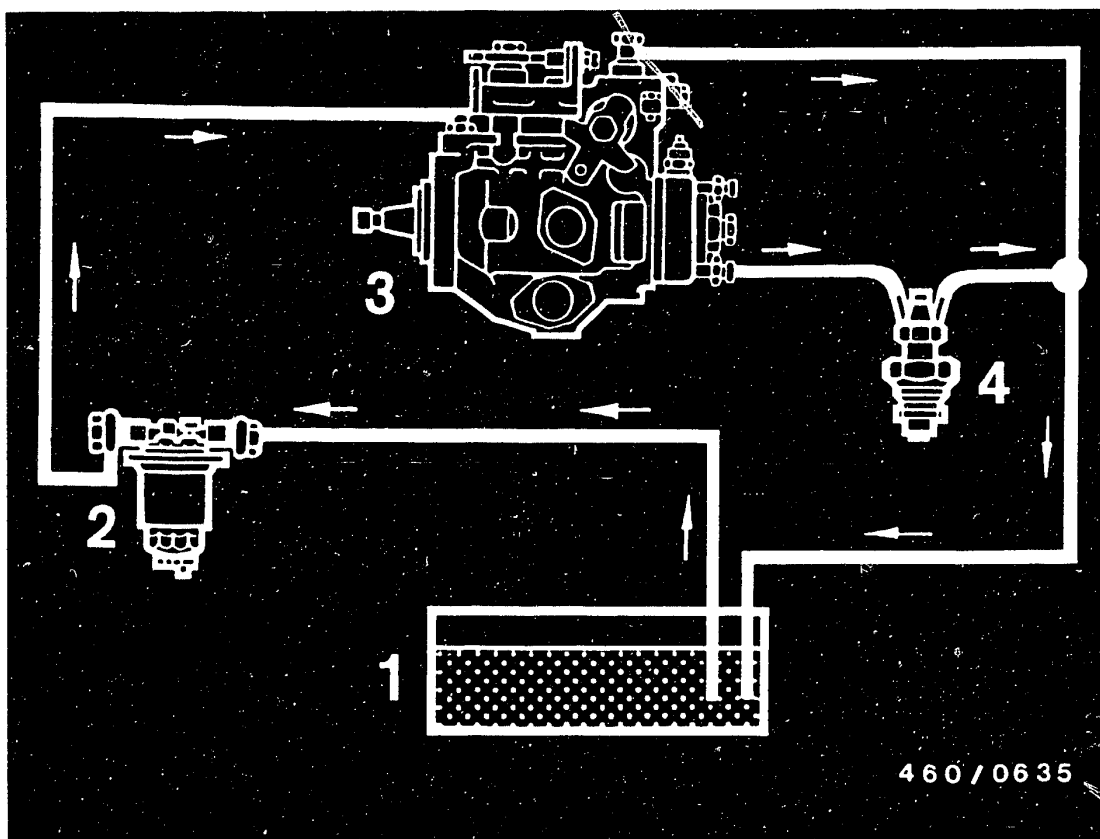
After the solenoid valve has been taken out, check its operation.

#### Note:

It is permissible to supply voltage to the solenoid valve only briefly when it has been taken out, since it lacks fuel cooling.

Check the valve seat in the hydraulic head (visual inspection).





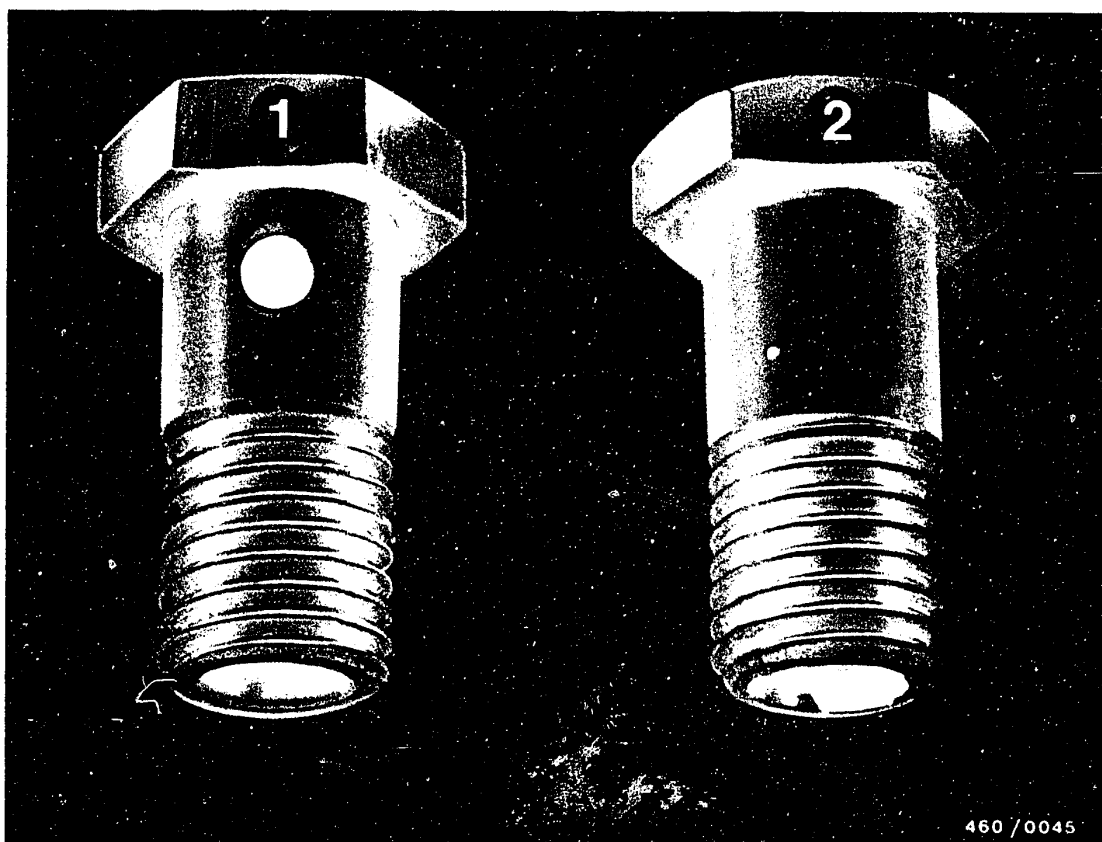
- 1 = Fuel tank
- 2 = Fuel filter
- 3 = Distributor-type fuel-injection pump
- 4 = Fuel-injection nozzles

#### 14. Connection diagram for fuel lines

The fuel lines have been connected as shown in the diagram above.

The fuel flows in the direction shown by the arrows.

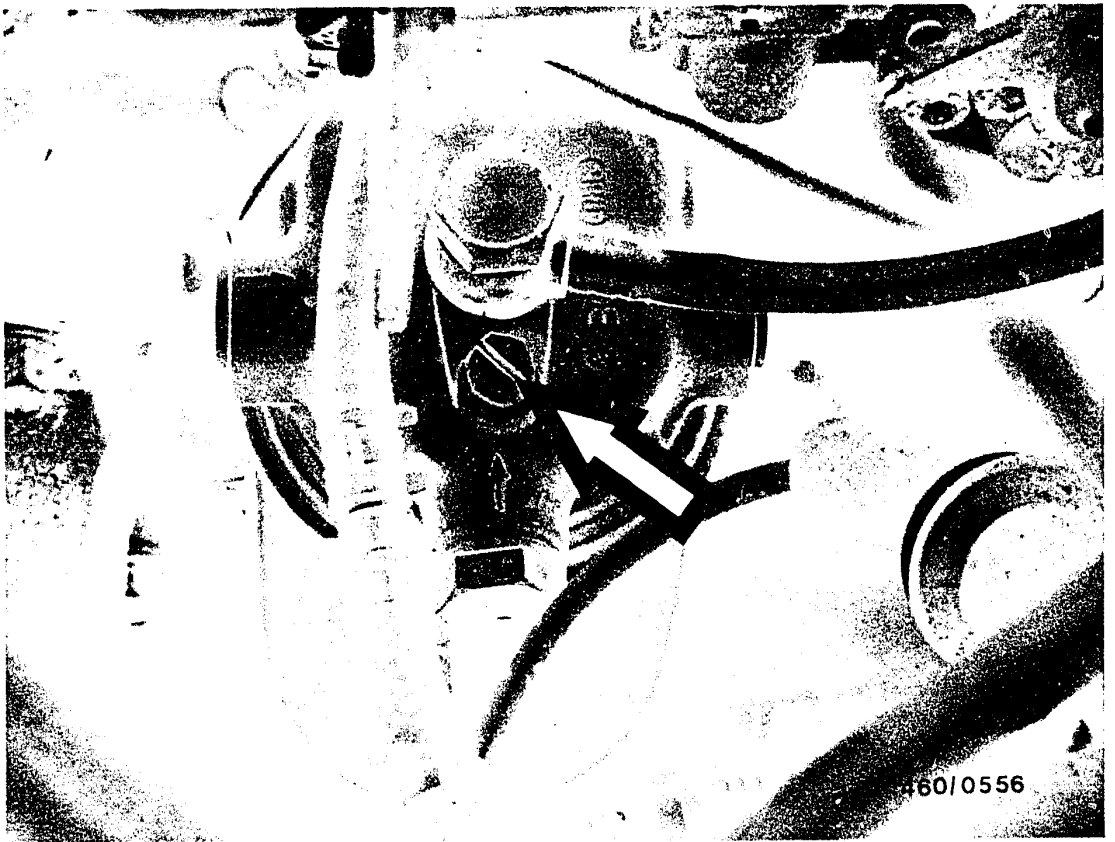




At the connections for the fuel-injection pump, make certain that the inlet-union screw for the fuel supply line (1) and the throttle screw for the fuel return line (2) are not mistaken one for the other.

The throttle screw is located on the cover of the fuel-injection pump and has been identified on the screw head with the word "out".





### 15. Bleeding the fuel system

Fill the fuel filter and the fuel-injection pump with diesel fuel.

Tighten the hose connections to the filter cover.

If there is a bleeder screw on the fuel filter, plug it (arrow).





Release the bleeder screw on the fuel-injection pump and unscrew it by a few turns (arrow).

Release the union nuts for the supply lines at the fuel-injection nozzle holders.

Turn on the engine starting motor without preheating. When the fuel coming out of the bleeder hole on the fuel-injection pump no longer has any bubbles, tighten the bleeder screw again.

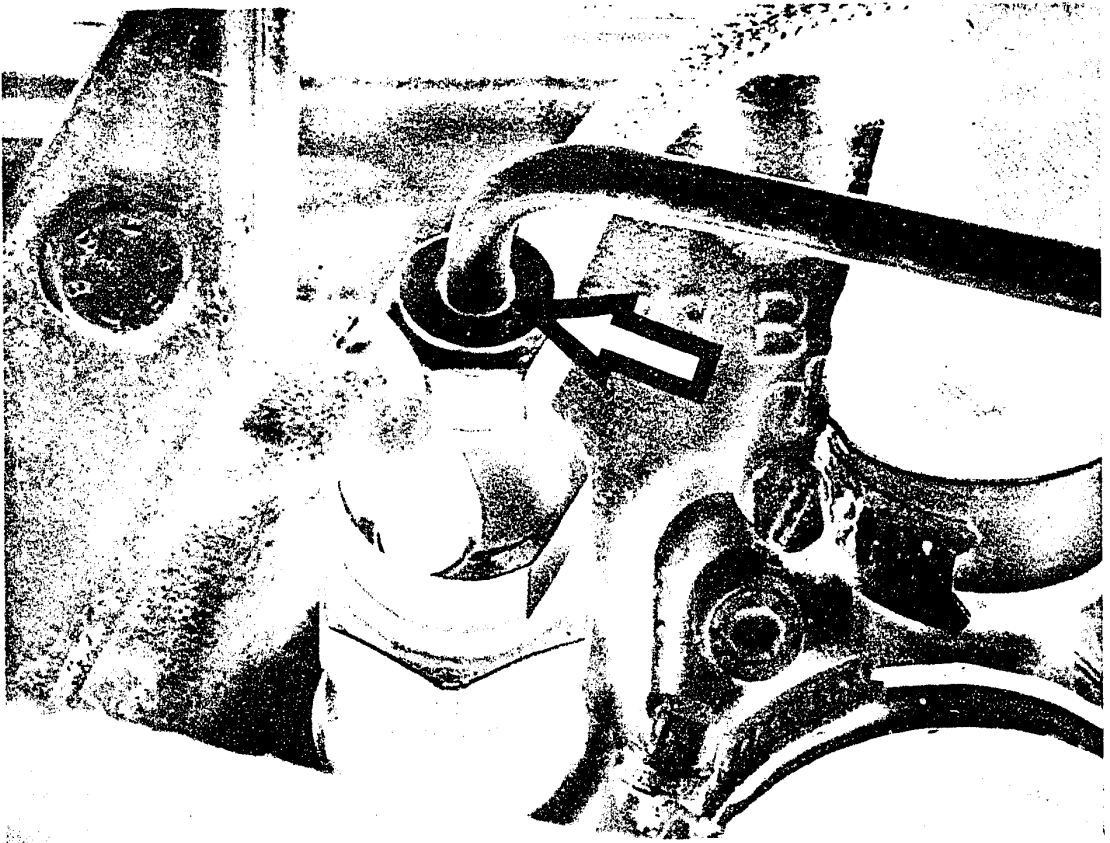
## **B 18**

Bleeding the fuel system

Volvo 240 D, 760 D-Turbo





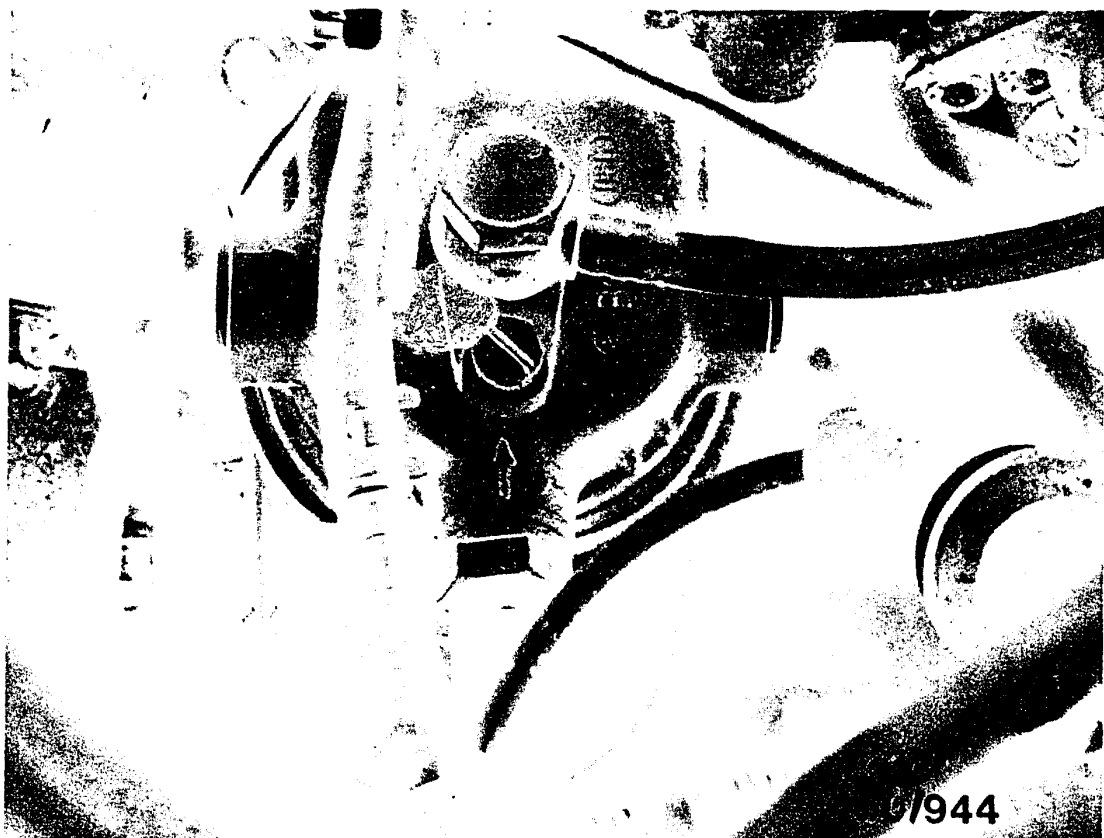


Start the starting motor again until fuel comes out at the union nuts on the fuel-injection nozzle holders (arrow).

Tighten the union nuts.

Turn on the starting motor until the engine starts.





## 16. Replacing and draining the fuel-filter box

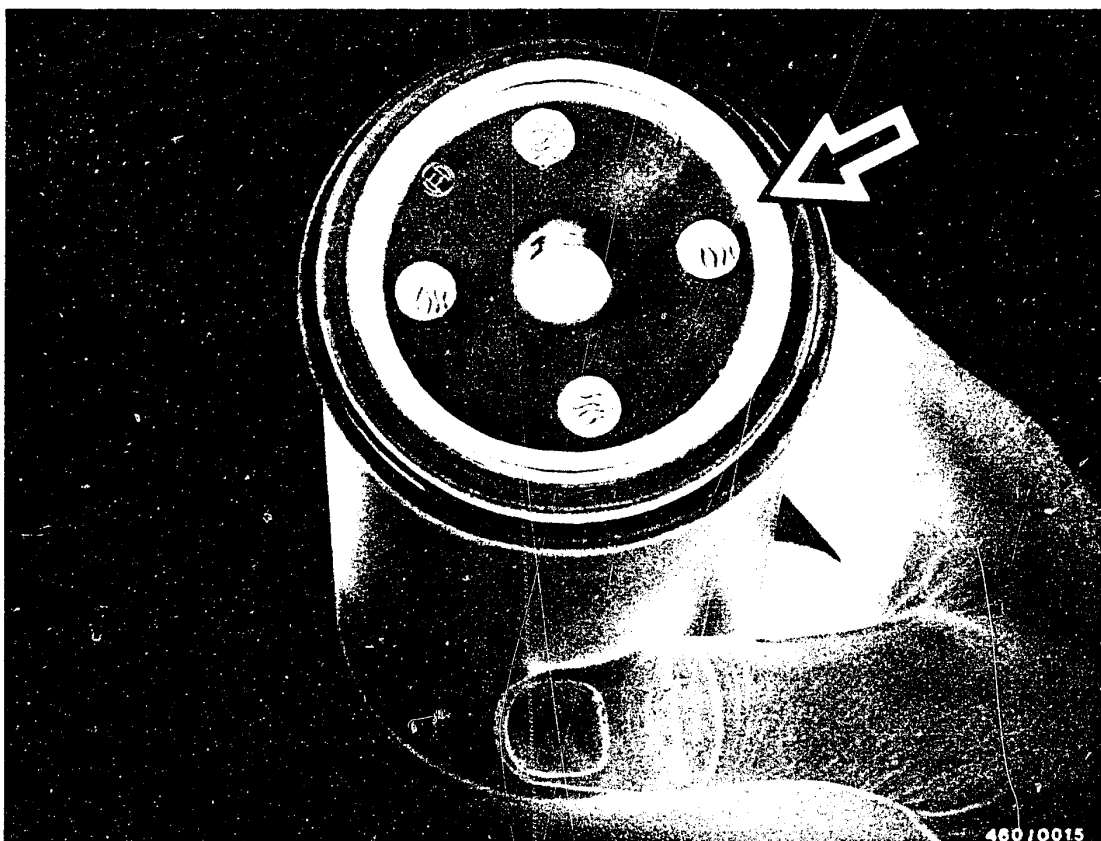
### 16.1 Taking out and replacing the fuel-filter box

Unscrew the fuel filter from the filter cover.

If the filter box sits in tight, release it using a special wrench, e.g., Matra W 167.

Catch the fuel that flows out.





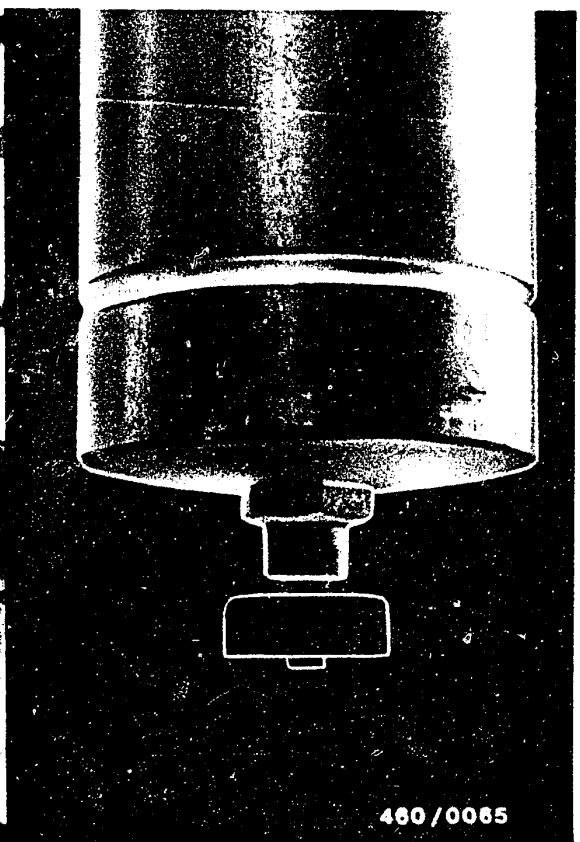
Rub diesel fuel in on the rubber seal (arrow) of the new filter box.

Screw the filter box into the cover by hand, and tighten it.

Check the fuel filter for leaks.

For winter fuel, under some circumstances, mix in kerosene according to specifications from the car manufacturer.





### 16.2 Draining the fuel filter

Release the bleeder screw (arrow) on the filter cover by a few turns.

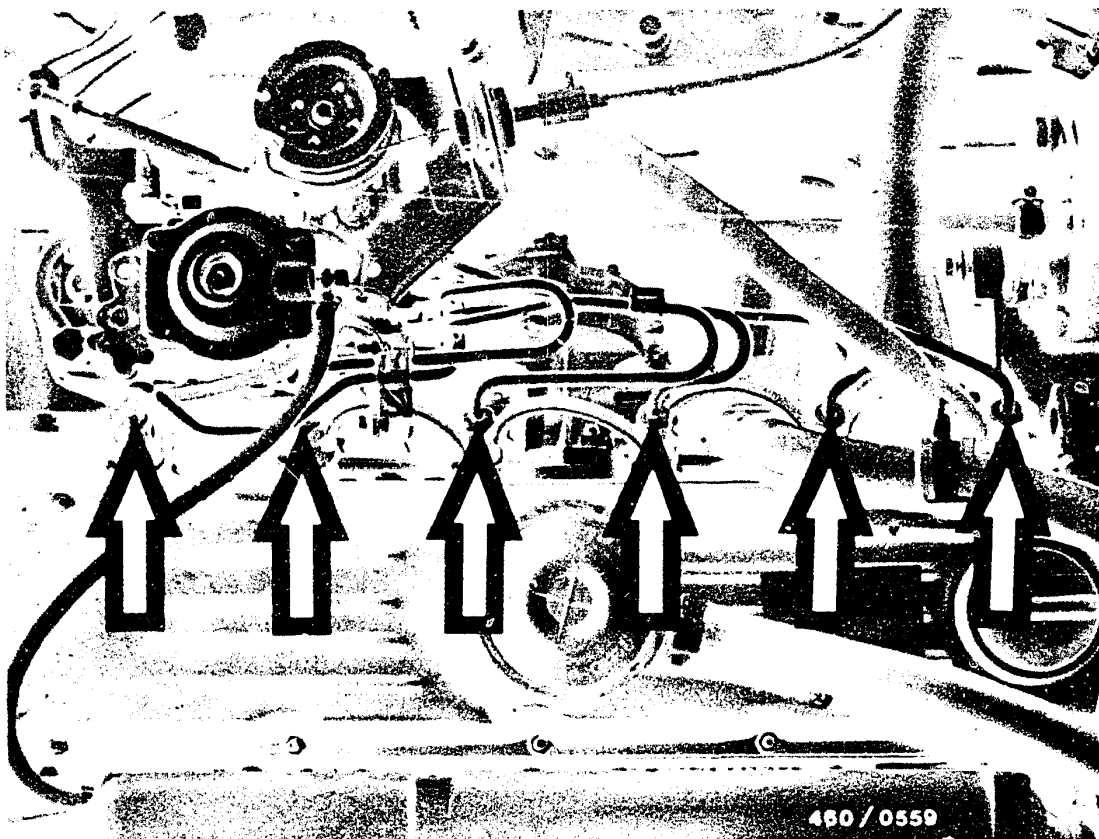
If there is no bleeder screw there, remove the leakage oil return hose on the last nozzle holder assembly.

Unscrew the water drain screw at the base of the filter and drain out approx. 100 cm<sup>3</sup> liquid into a collecting basin.

Tighten the water drain screw and the bleeder screw and check for leaks.

If the leakage hose has been disconnected, put it back on the nozzle holder assembly.





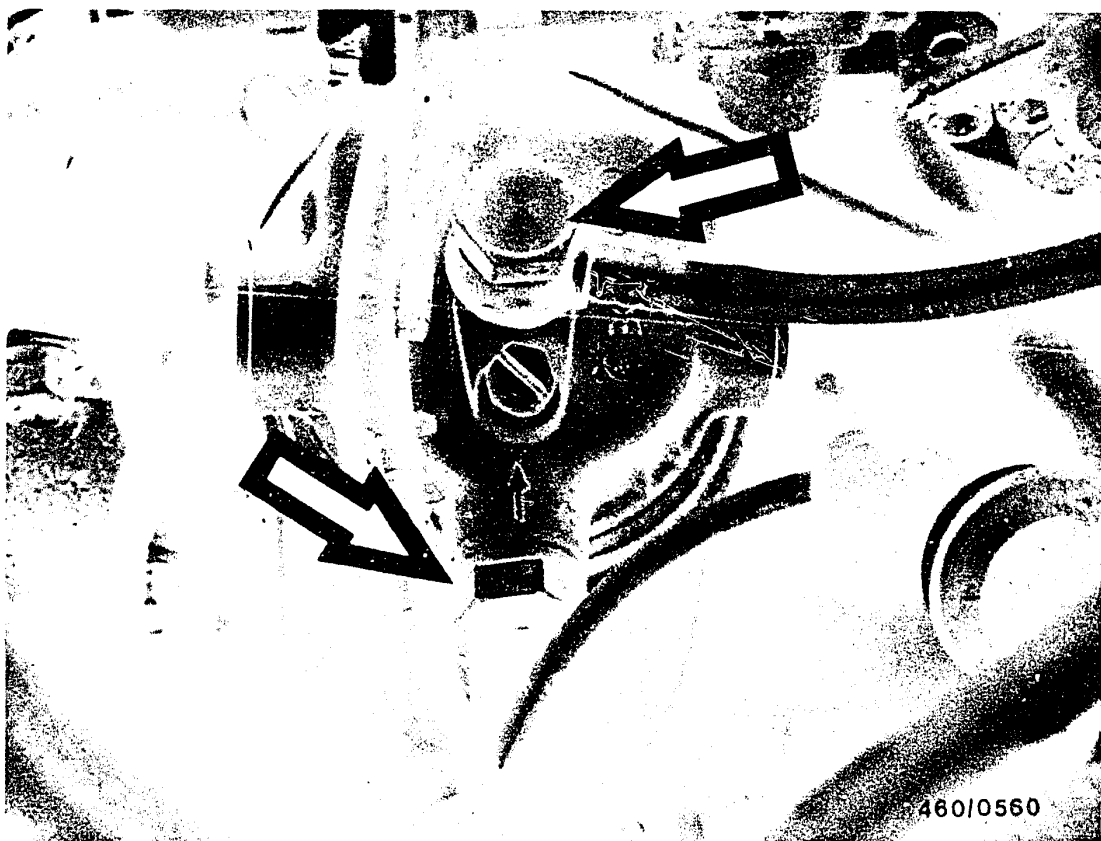
### 17. Checking the fuel-injection for leaks

Check for leaks with the engine at normal operating temperature.

When checking for leaks, check all fuel line connection points. Watch particularly:

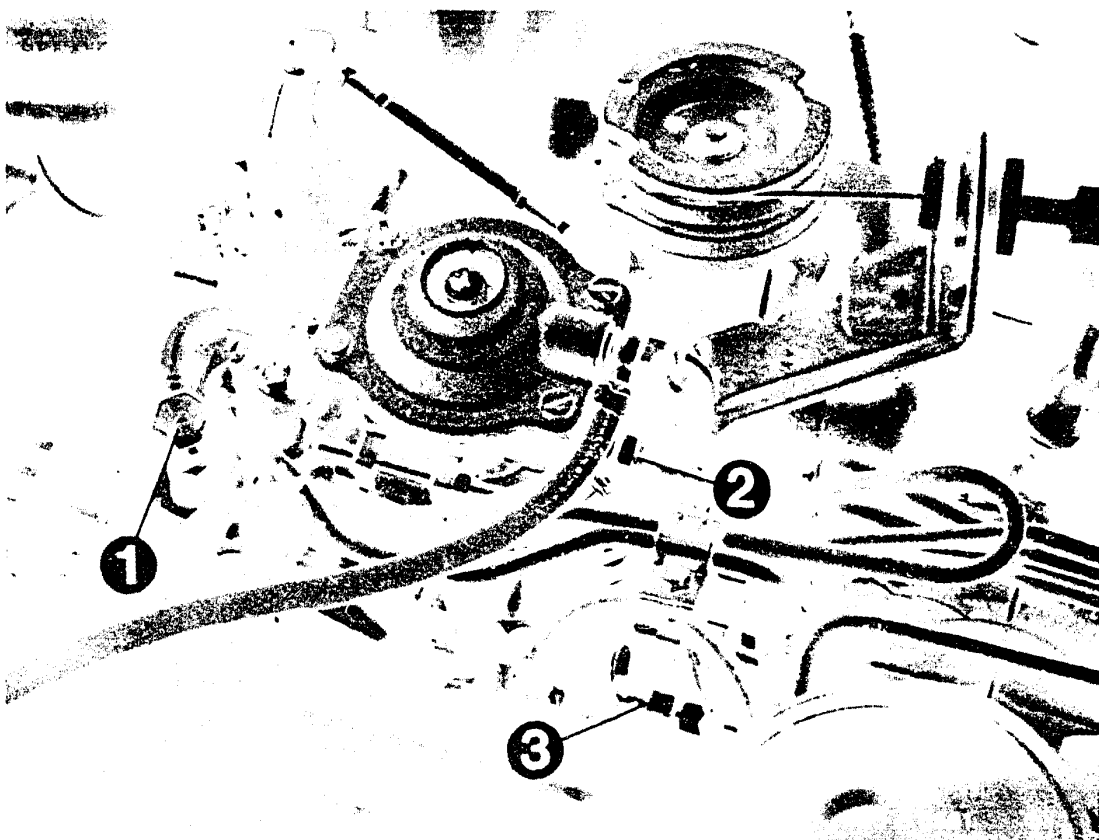
- Connections at the fuel-injection nozzle holder assemblies (arrows)





- Connections on fuel filter (arrow).

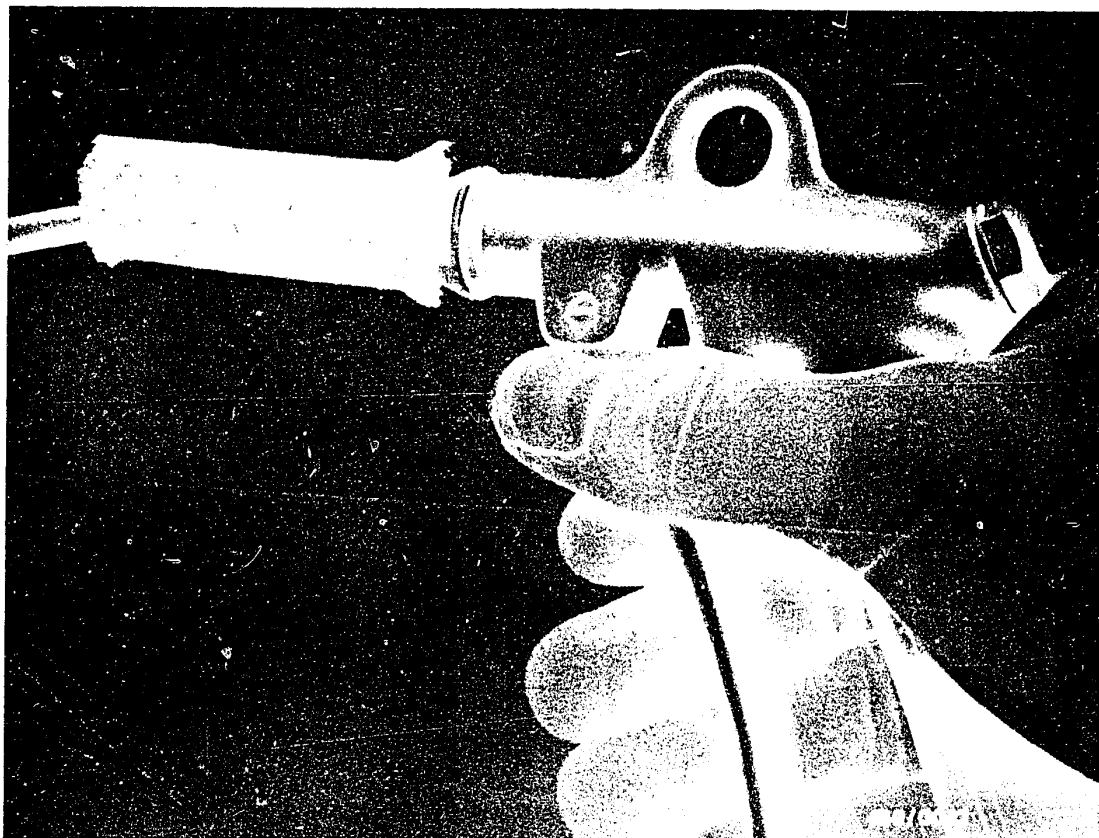




- Supply line (1) and return line (2) at the distributor-type fuel-injection pump.
- Delivery-valve holder on the hydraulic head (3).

Check fuel lines for hair-line cracks.





### 18. Checking fuel lines

Make a visual inspection of fuel lines to which some objection has been raised.

If no crimping or bending locations are identifiable, take out and replace the fuel line in question.

Using compressed air, check the fuel line for free passage and if need be clean it.

For blowing out the fuel lines, a suitable piece of hose can be used to provide a seal at the side.





## 19. Exhaust emission test - checking air filter

### 19.1 Exhaust emission test

Summary of the content of the legal regulations (as of April 1978):

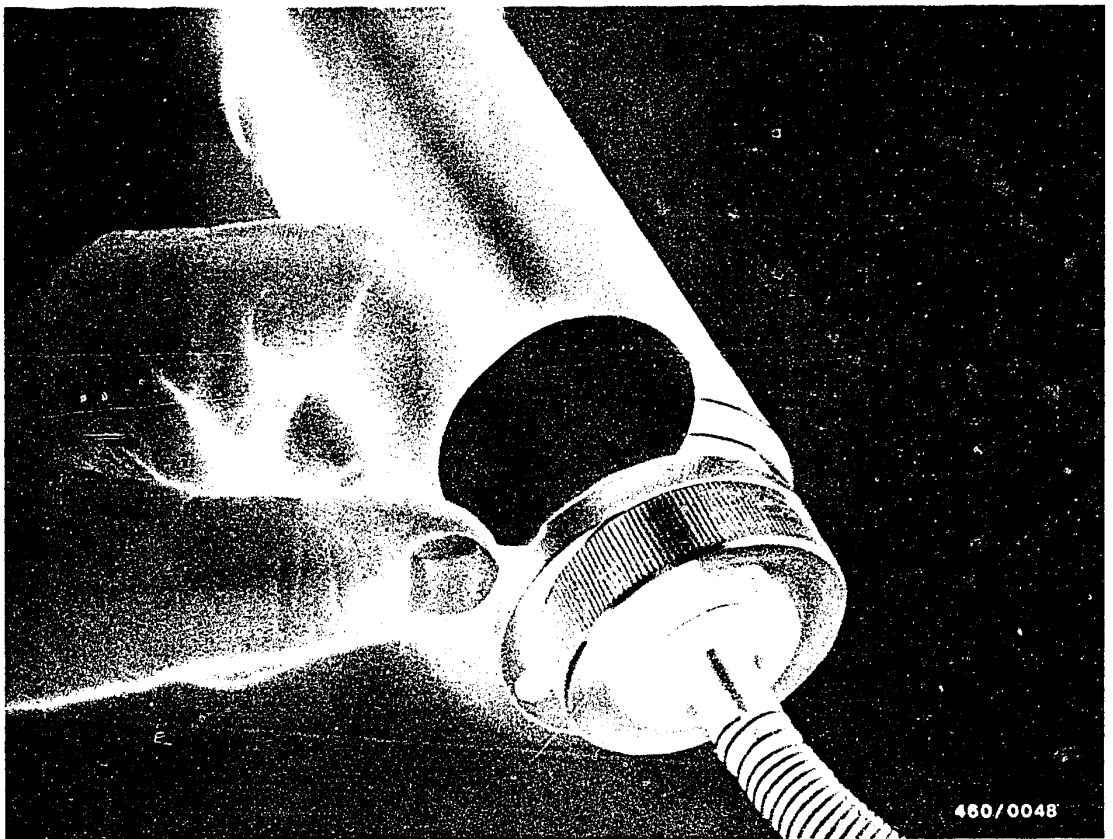
These regulations cover only motor vehicles with a minimum of four wheels, and a maximum allowable speed of more 25 km/h, which are being newly licensed. There is no check on exhaust emissions prescribed as part of the general inspection.

Parts that can affect environmental pollution must be designed in such a way that legal requirements are maintained while the vehicle is in operation despite its vibrations.

That applies in particular to cold-starting equipment and full-load stops.

In principle, approval is granted only by the Rheinland-Westfälischen TÜV (Rhineland-Westphalian Technical Supervisory Agency) in Essen.





## 19.2 Equipment for testing

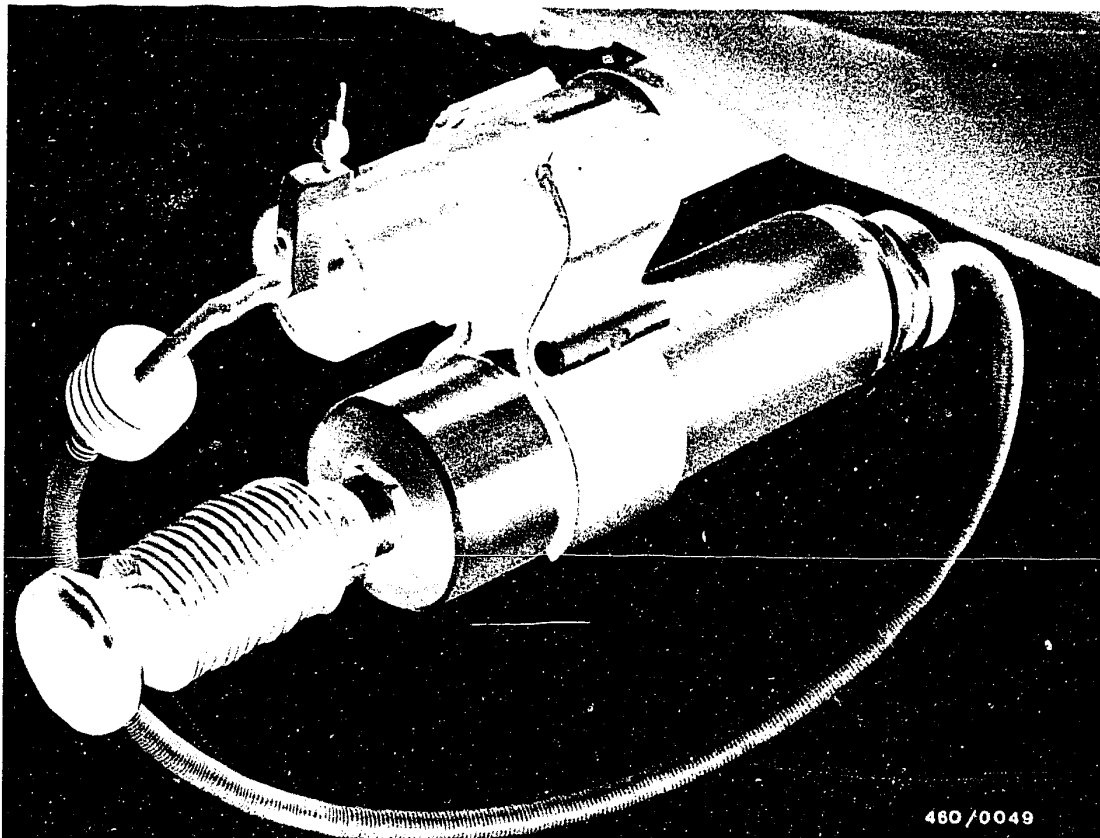
The exhaust emission test is run using the Bosch smoke analyzer.

The smoke analyzer consists of the following instruments:

- Accessory kit with metering pump 0 681 169 038
- Analyzer

Insert the filter disc into the metering pump.





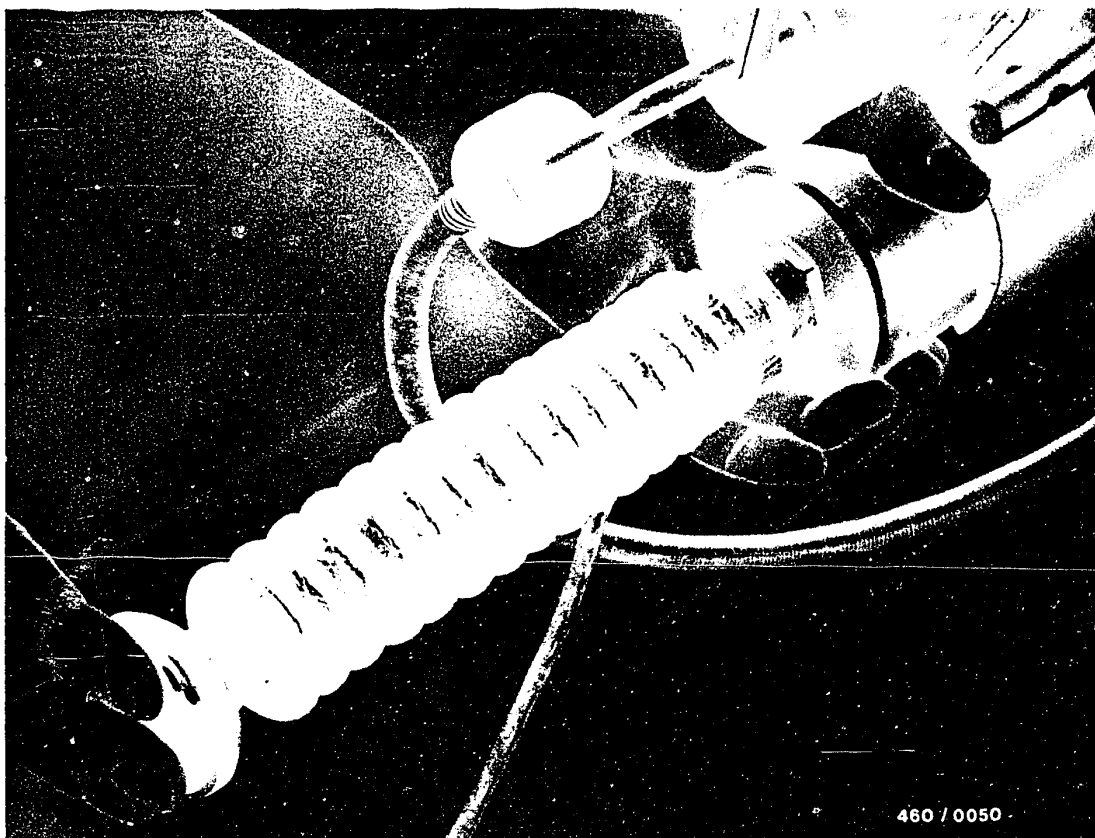
Fasten the metering device to the exhaust pipe using an appropriate bracket.

Insert the exhaust-sampling pickup as deep as possible into the exhaust pipe and clamp it firmly in place.

**C5**

Exhaust emission test  
Volvo 240 D, 760 D-Turbo





### 19.3 Test procedure

Stress the metering pump by shoving in the black push-button knob.

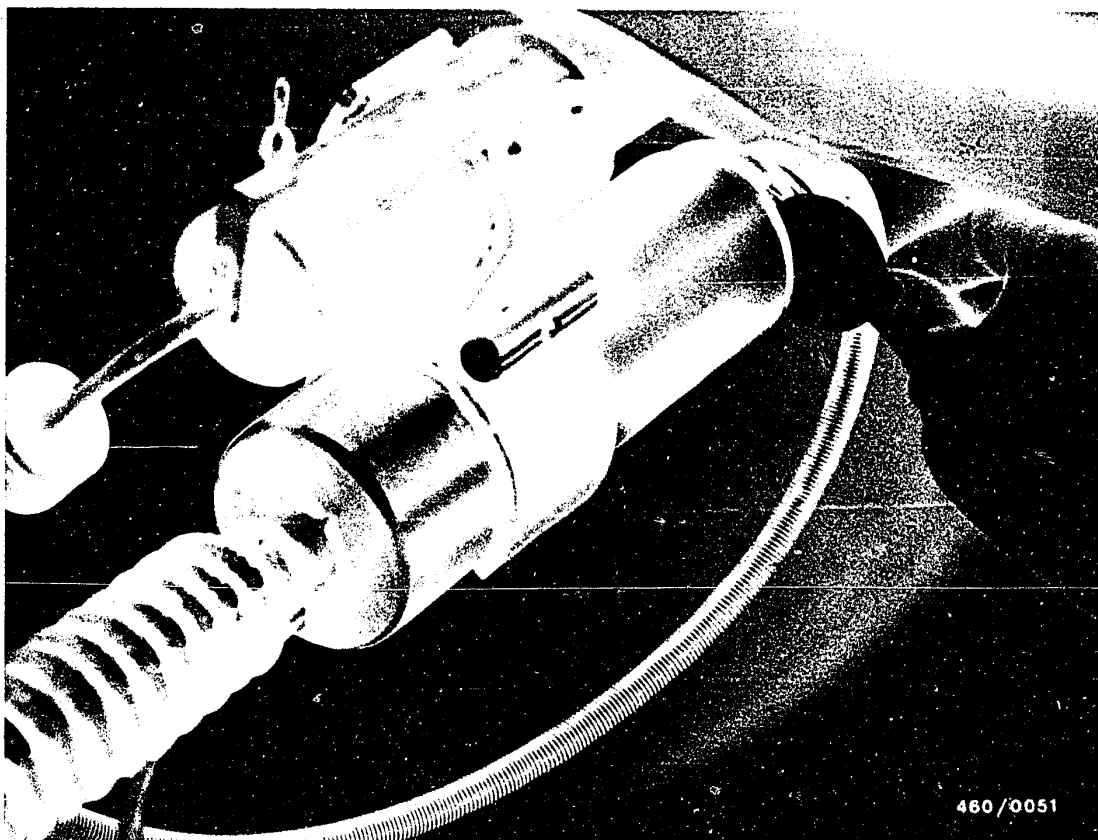
Take the rubber ball on the release hose along into the passenger compartment.

The test can be run either on the "roller" (chassis dynamometer) or on the street (slope).

In all cases, prefer testing on the chassis dynamometer. Look for the gear setting in which a speed of approx. 40 km/h is attained with the accelerator pedal all the way down.

Apply enough load to the engine so that with the accelerator pedal in the same position, a speed of approx. 25 km/h is attained.





Maintain this load condition for 5 seconds, then trigger the metering device by pressing on the rubber ball.

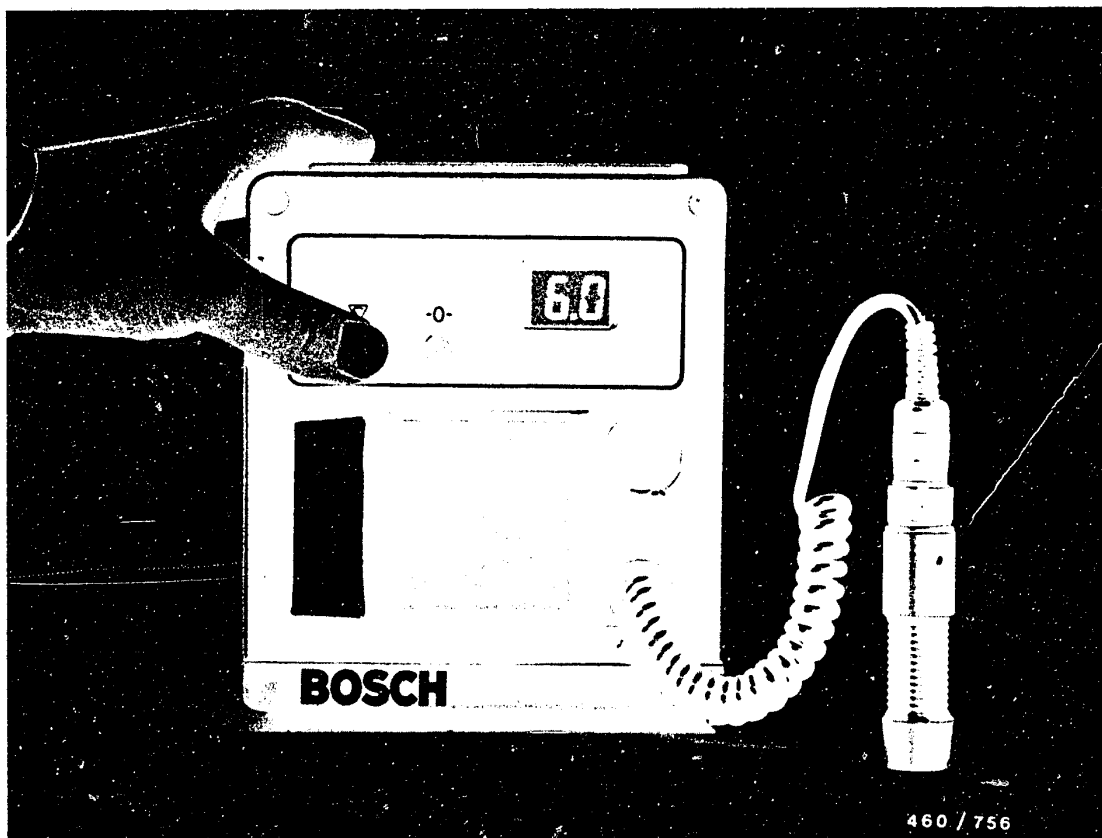
Shut off the motor.

C a u t i o n !

In the next step, make certain that the exhaust pipe is heated by the running engine.

Remove the filter disc from the metering device.





### Adjustment of the zero point

The zero-point compensation must be carried out

- before every series of tests
- with changes in ambient conditions
- after every cleaning of the lens in the photovoltaic cell adapter.

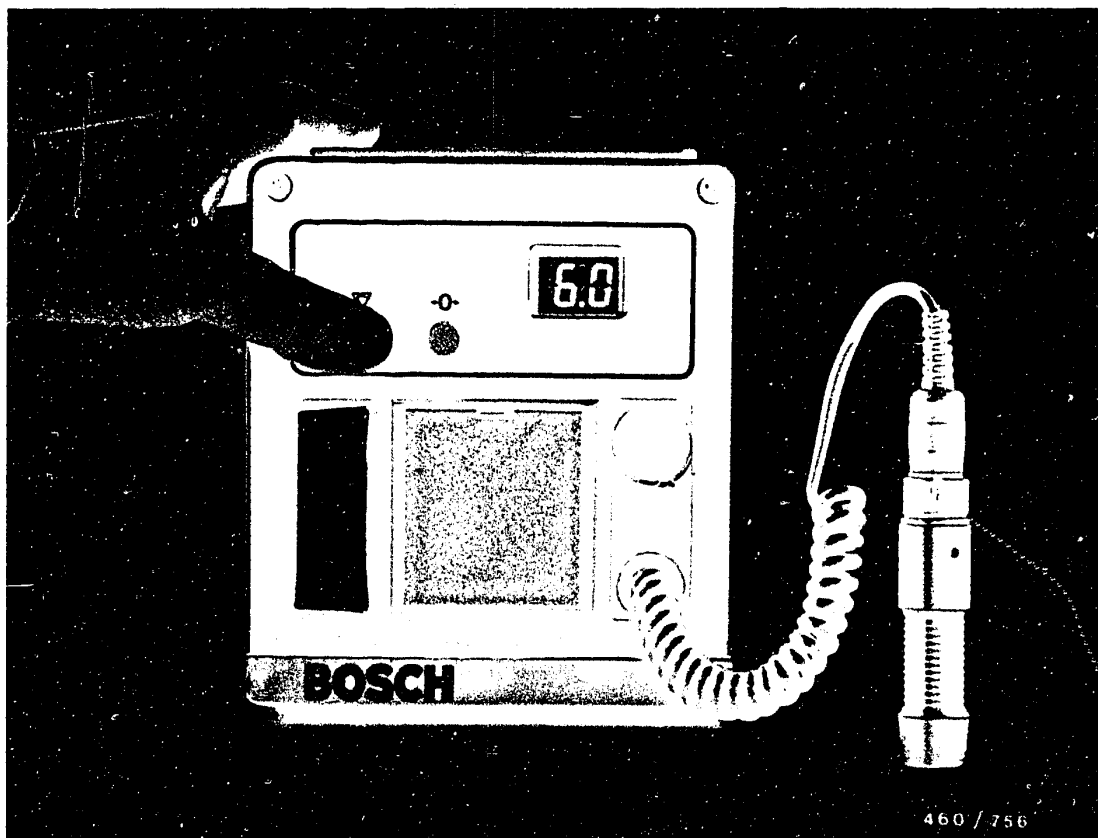
Lay 5 clean white filter discs one on top of the other, and press the measuring head of the photovoltaic cell adapter firmly on them.

Press the button "0", until the reading 0.0 appears. Release the button "0".

**C8**

Exhaust emission test  
Volvo 240 D, 760 D-Turbo





### Measurement

Lay 3 new filter discs one on top of the other and place the filter disc from the metering instrument with its soot side up on top of them.

Press the measuring head vertically against the black surface of the filter disc.

At the same time, press button "C" until the blackening coefficient measured appears in the display.

### Note:

Both in the zero point compensation and in the measurement itself, the measuring head must be set down firmly (even a slight tilting can cause errors in measurement).

Compare the blackening coefficient measured with the evaluation sheet.

In so doint watch the BHP data from the car manufacturer.

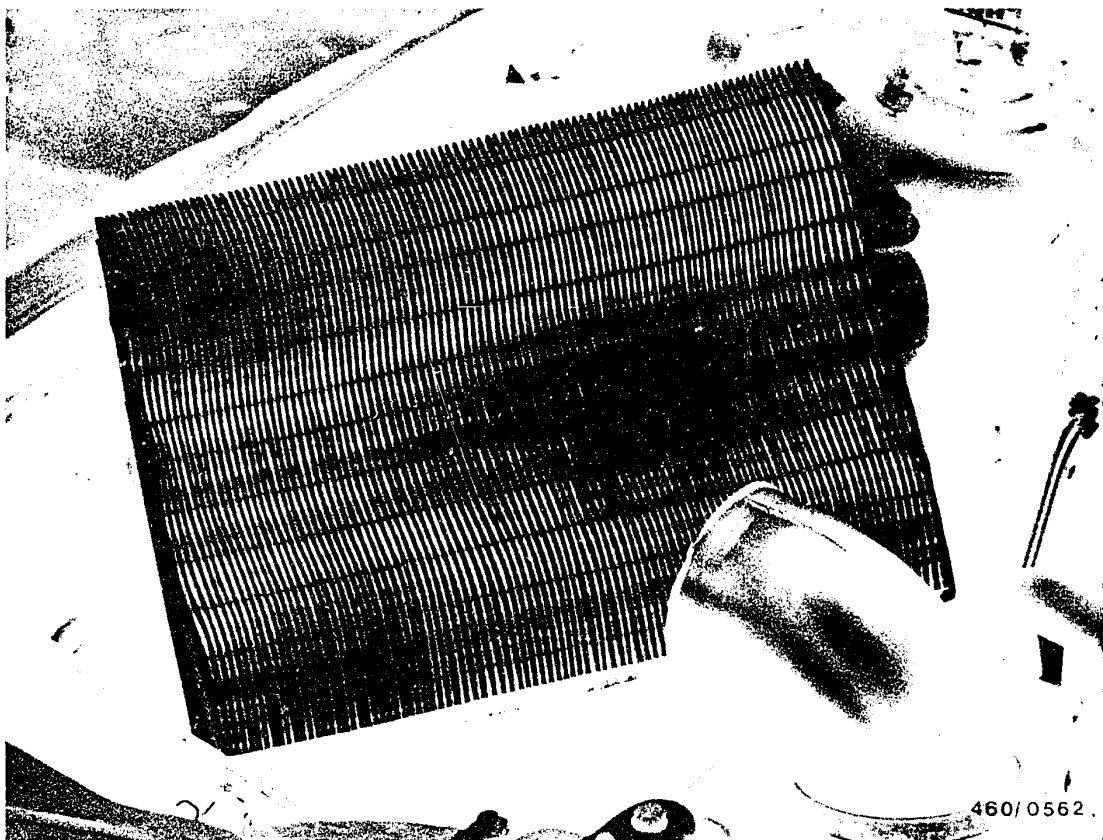
**C10**

Exhaust emission test

Volvo 240 D, 760 D-Turbo







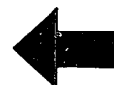
#### 19.4 Checking the air filter

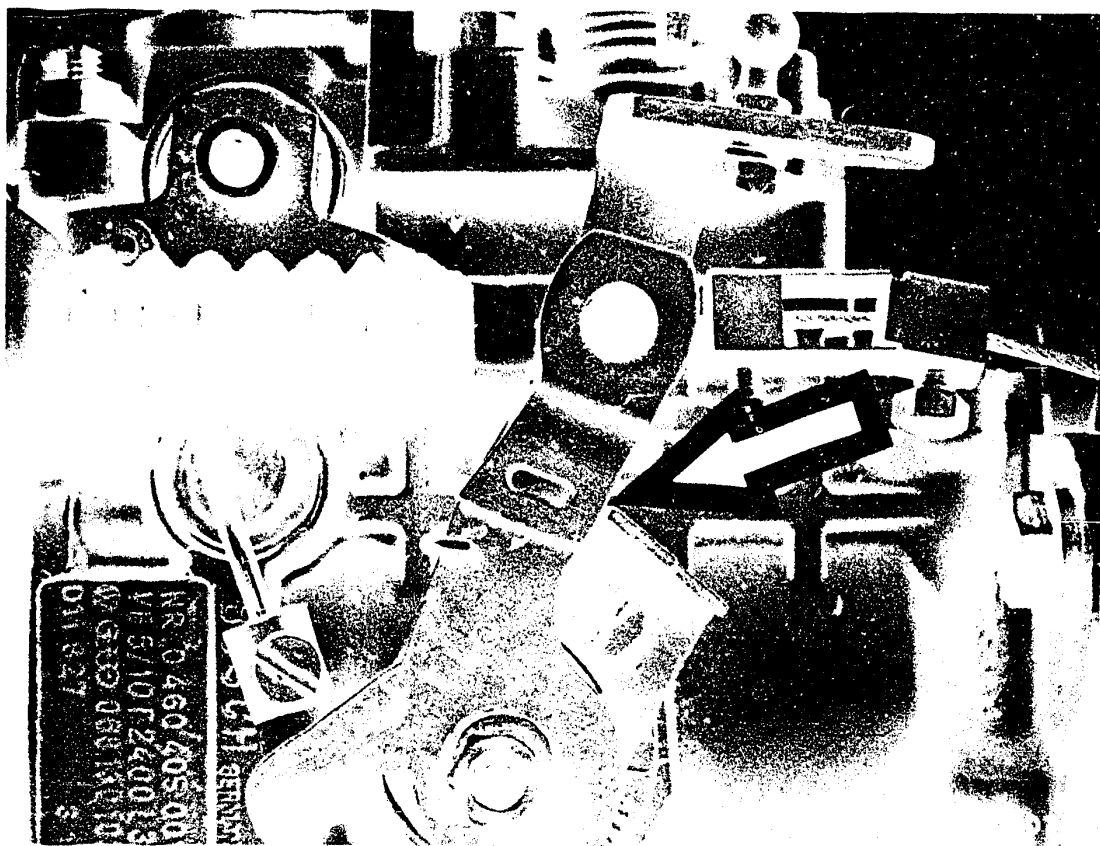
Take out the air filter and subject it to a visual inspection.

##### Test criteria for the air filter:

- Air filter covered with dust (check by beating the air filter)
- Air filter covered with oil
- Solid pieces in the air filter, e.g., leaves.

Where there are doubts, use a new filter insert.





## 20. Idle speed adjustment

Connect the tachometer (e.g. photoelectrically) to the engine.

Start the engine and run it at idle speed.

### N.B.!

For adjustment of the idle speed, the engine must be at normal operating temperature.

The control lever of the cold-starting accelerator must be against the stop bracket (arrow).

Cooling water temperature  $+80^{\circ}\text{C}$ .



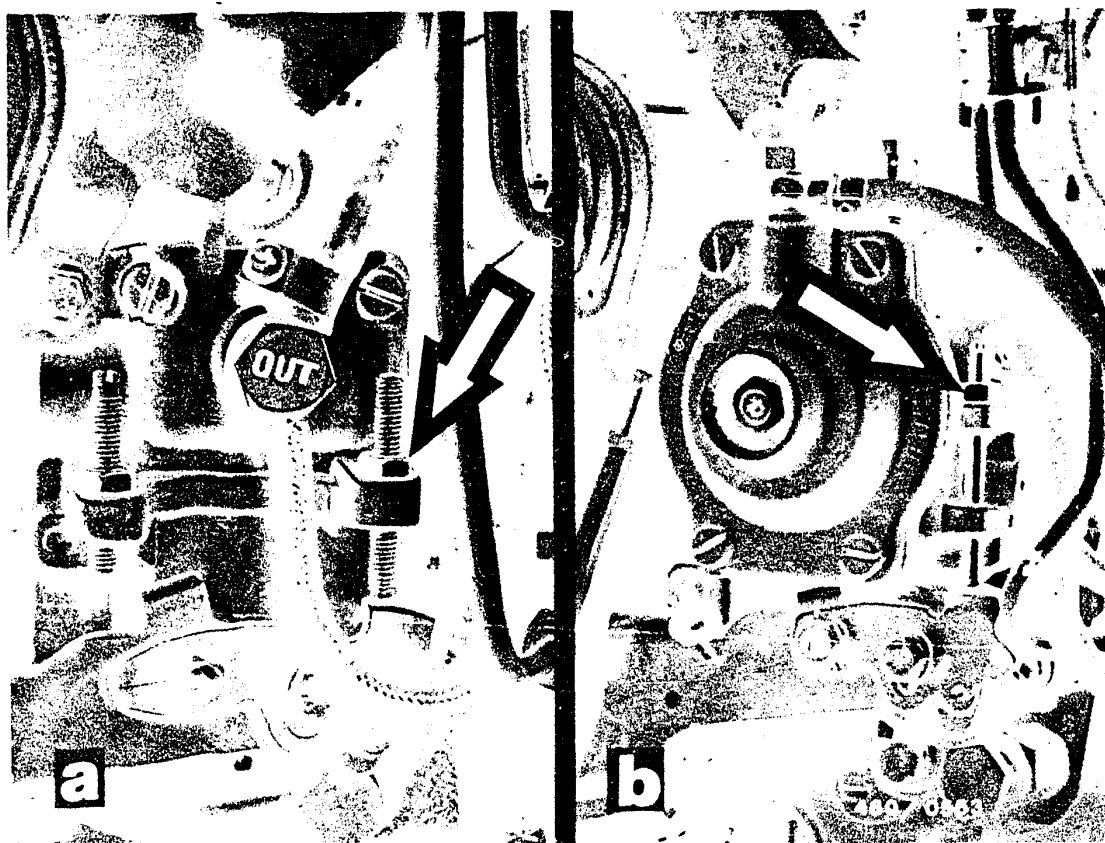


Fig. a = Induction engine (D 24)

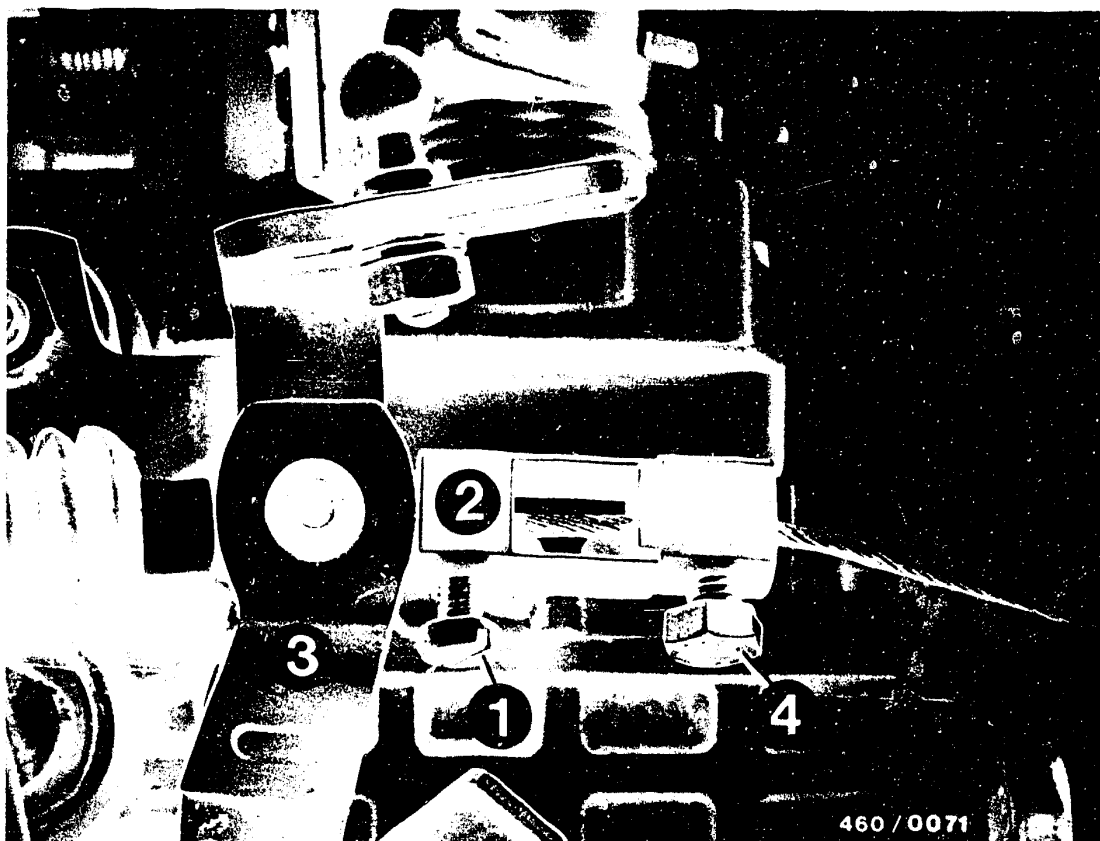
Fig. b = Turbo engine (D 24 T)

Using the idle adjustment screw (arrow), set the engine speed at  $750 \pm 50 \text{ min}^{-1}$ .

Make certain that the camshaft of the engine and the fuel-injection pump are driven at half engine speed.

After the adjustment, lock the adjusting screw in place and seal it.





### 20.1 Adjusting the accelerator cable

Release the clamping screw (1) on the fuel-injection pump. Pull the spacer piece (2) and the control lever (3) toward the hydraulic head.

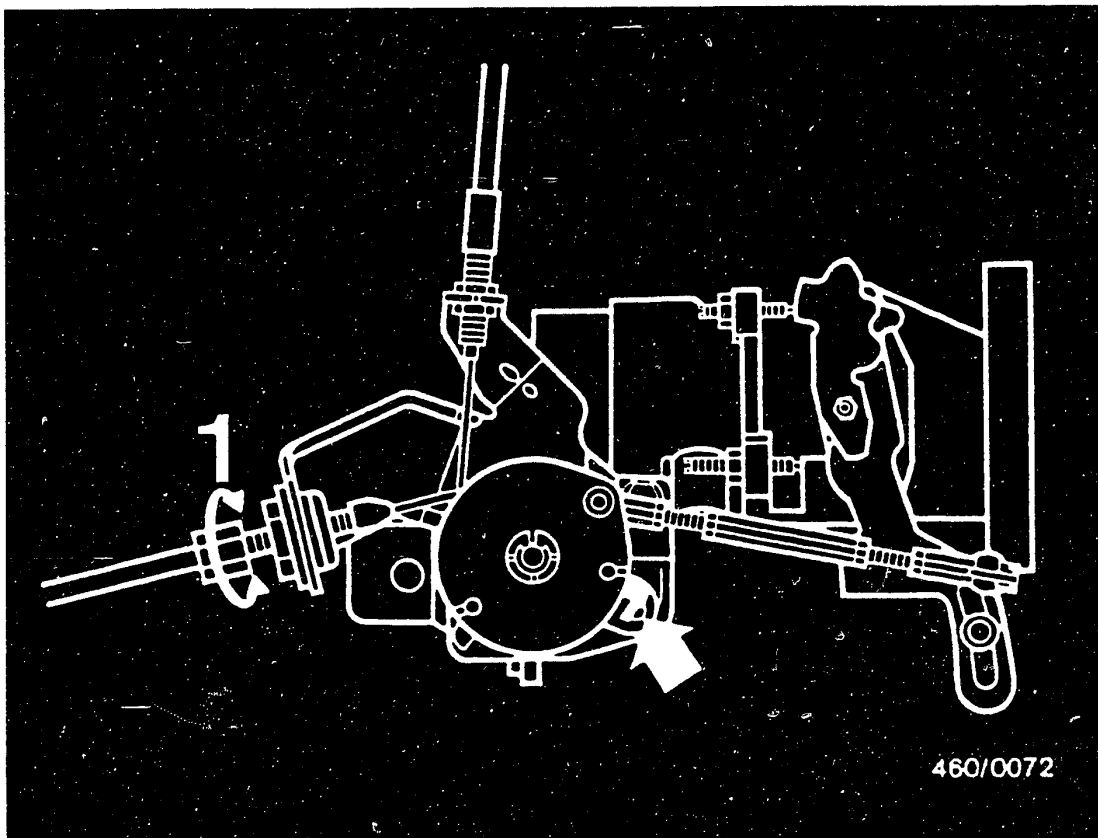
Turn the spacer piece (2) by 90° and shove it again toward the drive shaft, until the control lever (3) touches against the stop bracket.

In this position, the control device is shut off.

#### N.B.!

It is not permissible to release the screw (4)! That would make it necessary to readjust the control device.



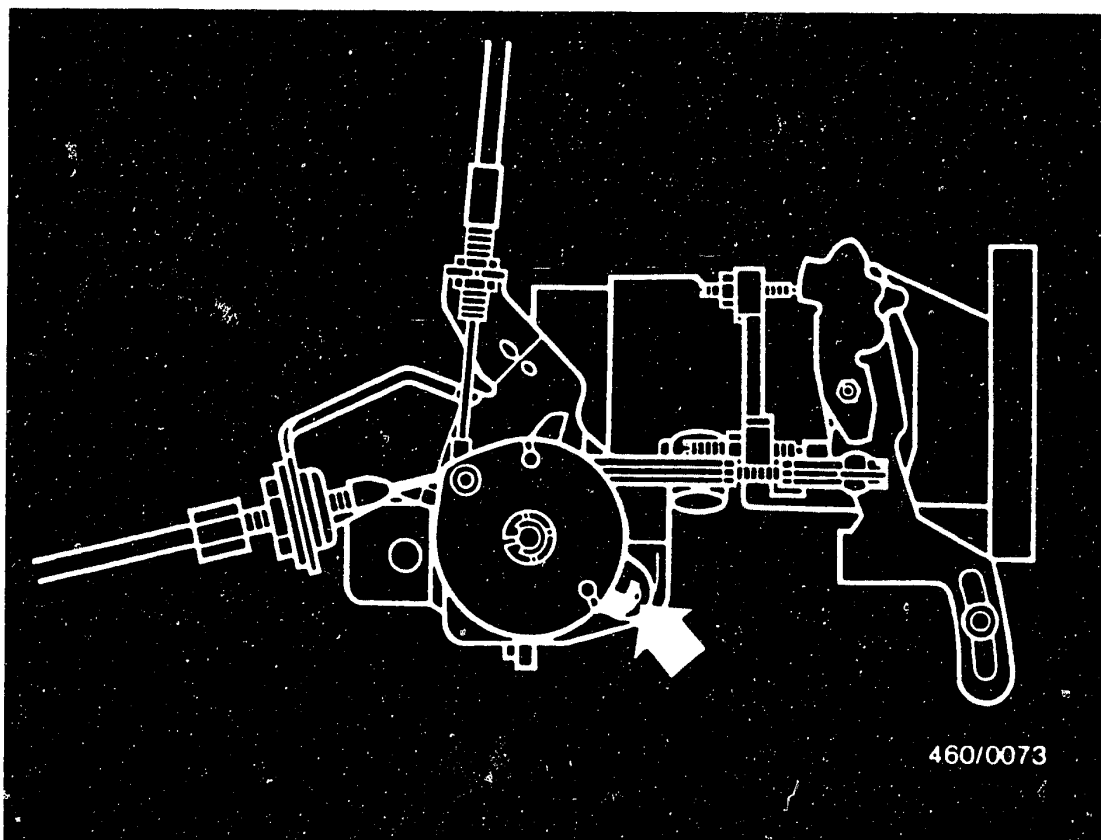


460/C072

Adjust the cable casing. (1) in such a way that the cable is tensioned but the guide pulley does not lift off from the stop (arrow).

In so doing, take out the connection on the control lever of the fuel-injection pump.



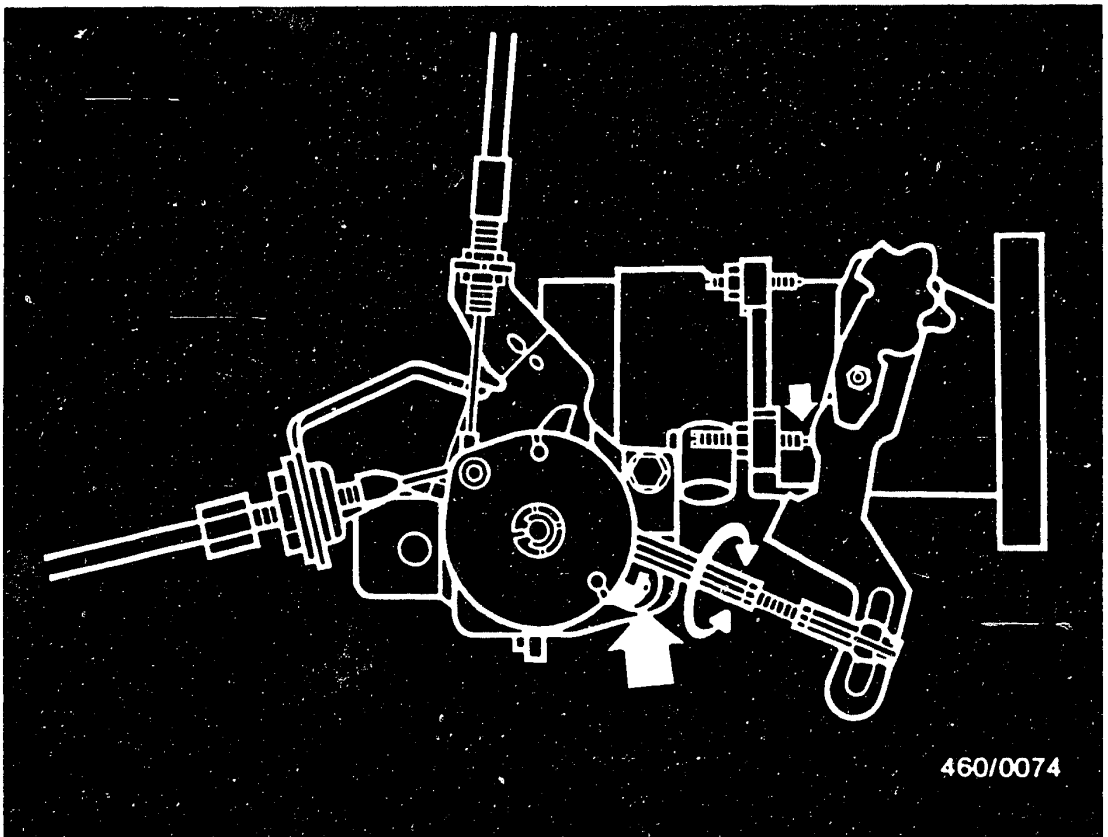


## 20.2 Checking full throttle adjustment

Press the accelerator pedal right down.

When this is done, the guide pulley must lie up against its end stop (arrow).

If need be, correct the adjustment of the cable.

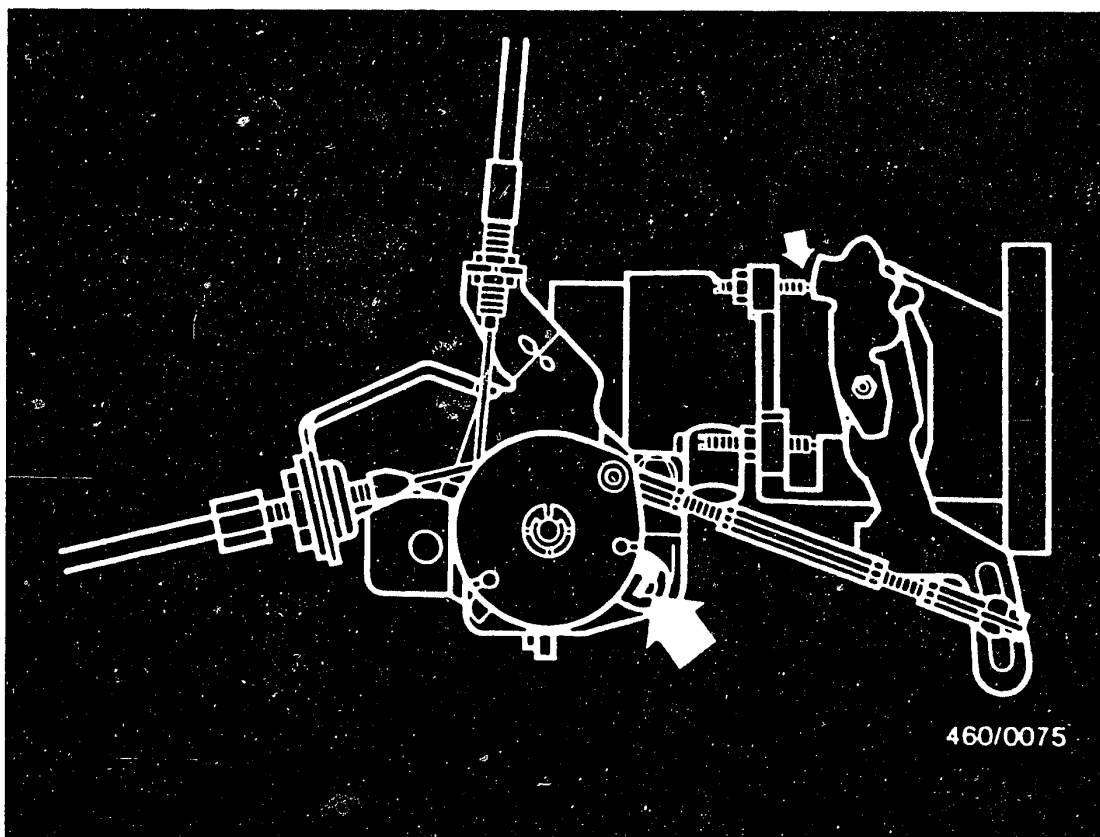


### 20.3 Adjusting the full-throttle setting on the throttle linkage

Put in the connector piece at the control lever of the fuel-injection pump.

Put the pulley guide up against the end stop.

Adjust the connecting linkage to the control lever of the fuel-injection pump in such a way that the control lever lies up against the maximum speed stop.



#### 20.4 Adjustment of low idle speed

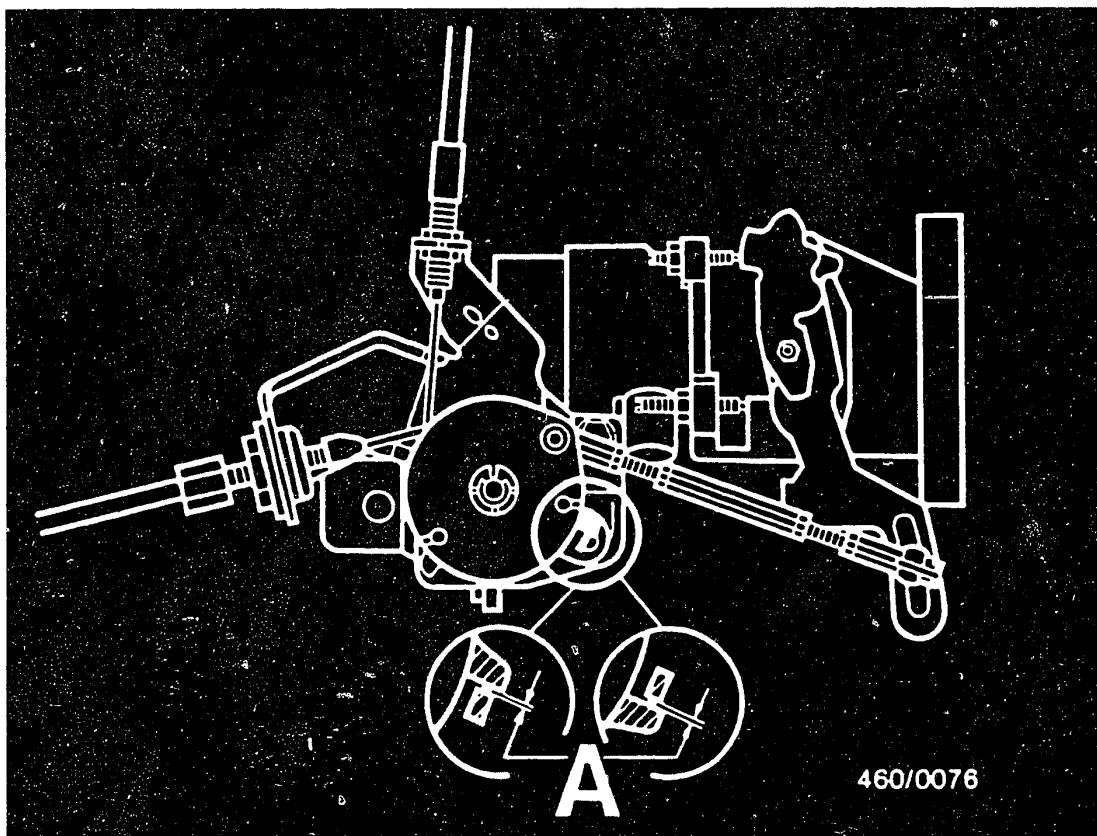
Put the guide roller up against the idle speed stop.

When this is done, the control lever of the fuel-injection pump must lie up against the idle speed stop screw of the injection pump.

Make correction by turning the ball joint.

After this correction, the adjustment of the maximum speed stop must be rechecked (reciprocal correction).



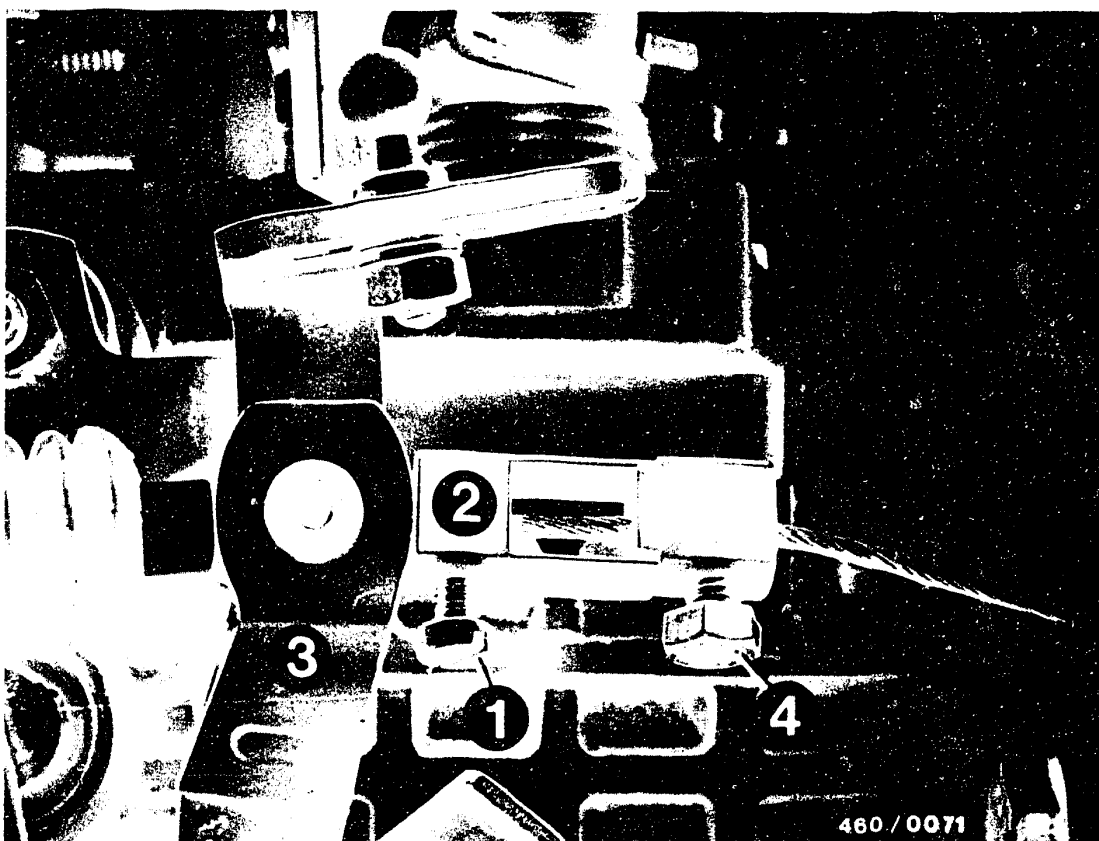


A = max. 0.3 mm

### 20.5 Precision adjustment on the throttle linkage

After the precision adjustment, check the clearance for the guide roller to the stop on both sides.

The clearance must not exceed 0.3 mm.

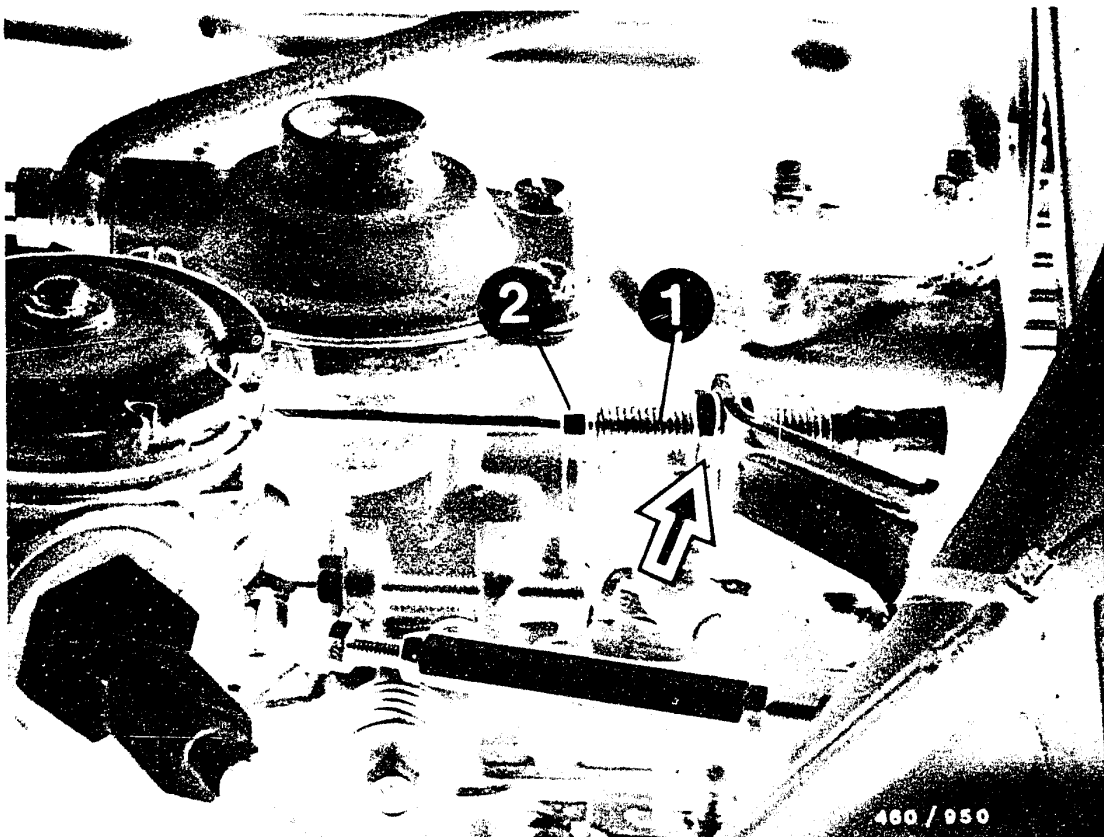


Pull the control lever (3) with the spacer piece (2) toward the hydraulic head.

Turn the spacer piece (2) by 90° and shove it again toward the drive shaft.

The spacer piece is now in its initial position.

Tighten the clamping screw (1).



## 21. Kick Down adjustment

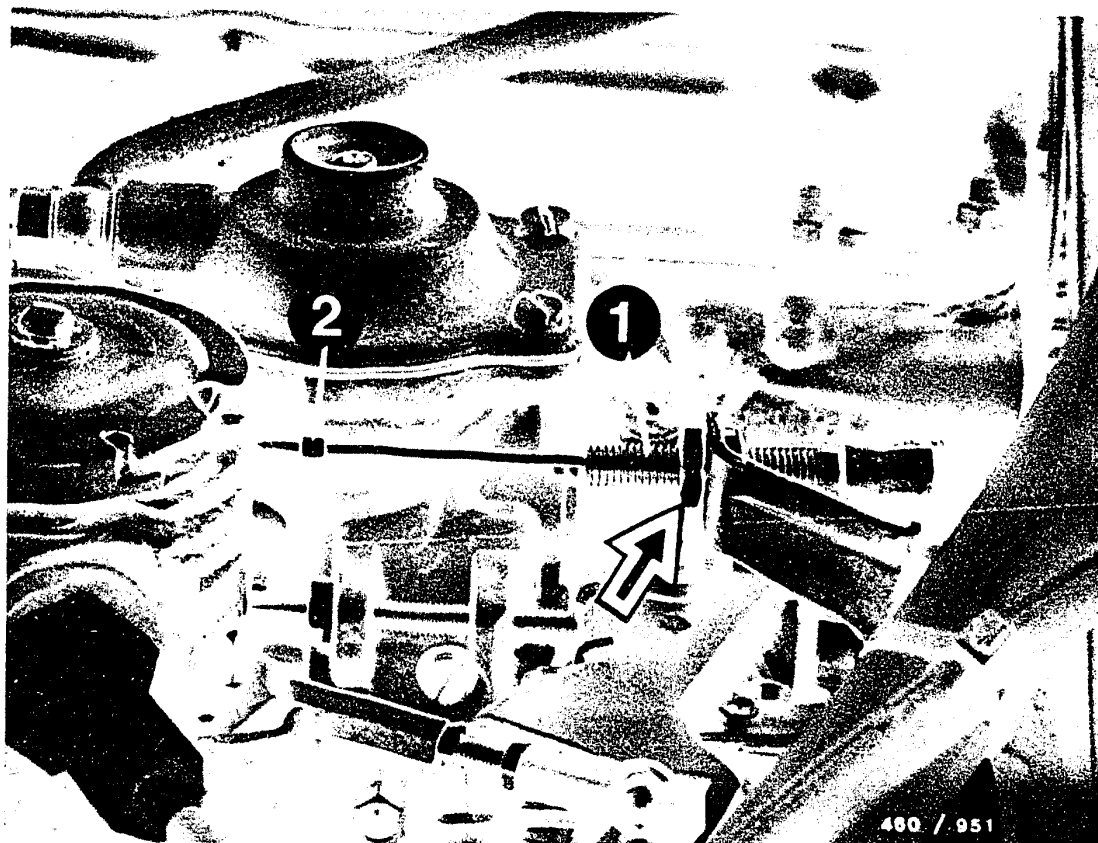
Requirement:

- Engine at normal operating temperature, cooling water temperature  $+80^{\circ}\text{C}$ .

Adjustment made at idle.

- Release the lock nut (arrow) and set the guide sleeve (1) at a distance from 0.25 ... 1.0 mm to the cable clamp (2).
- Tighten the lock nut and check the setting.





### Adjusting the kick down point

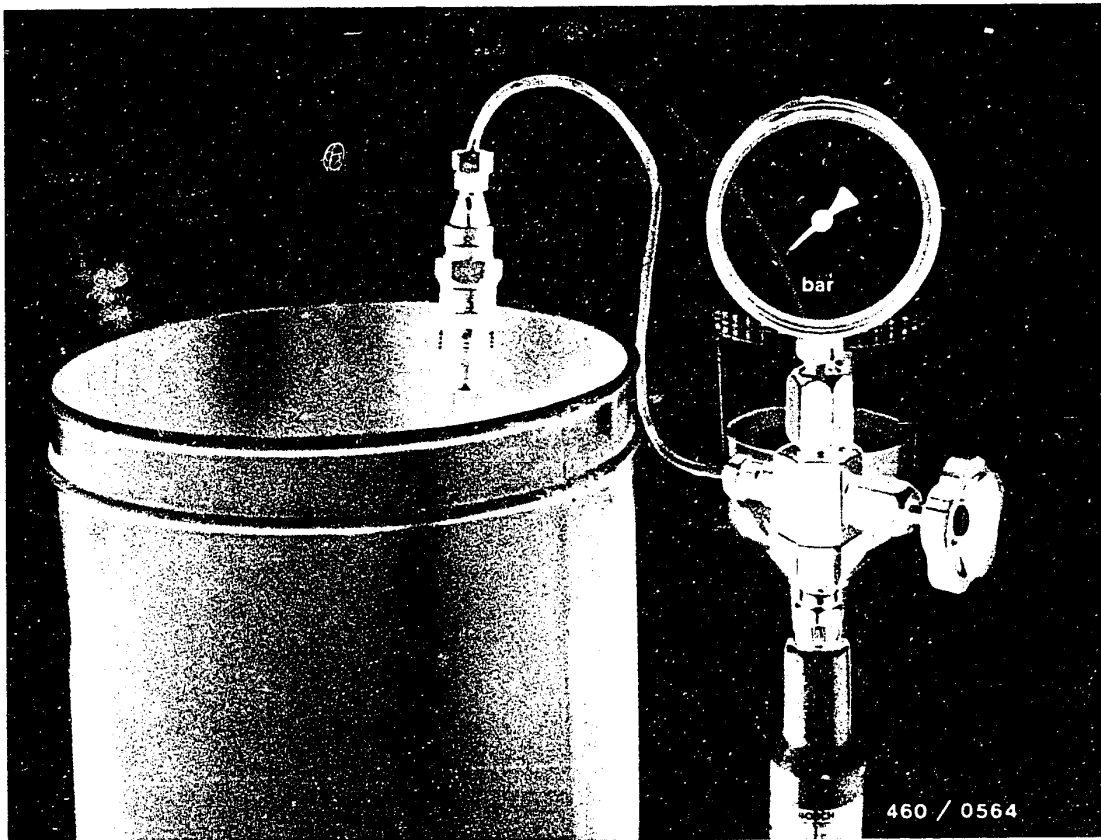
- Push the accelerator pedal down to the Kick Down point.
- Release the lock nut (arrow) and set the guide sleeve (1) to a distance of

+ 1.6  
51 - 0.6 mm

to the cable clamp (2).

- Tighten the lock nut, check the setting.





## 22. Checking the fuel-injection nozzles

Take out the fuel-injection nozzles.

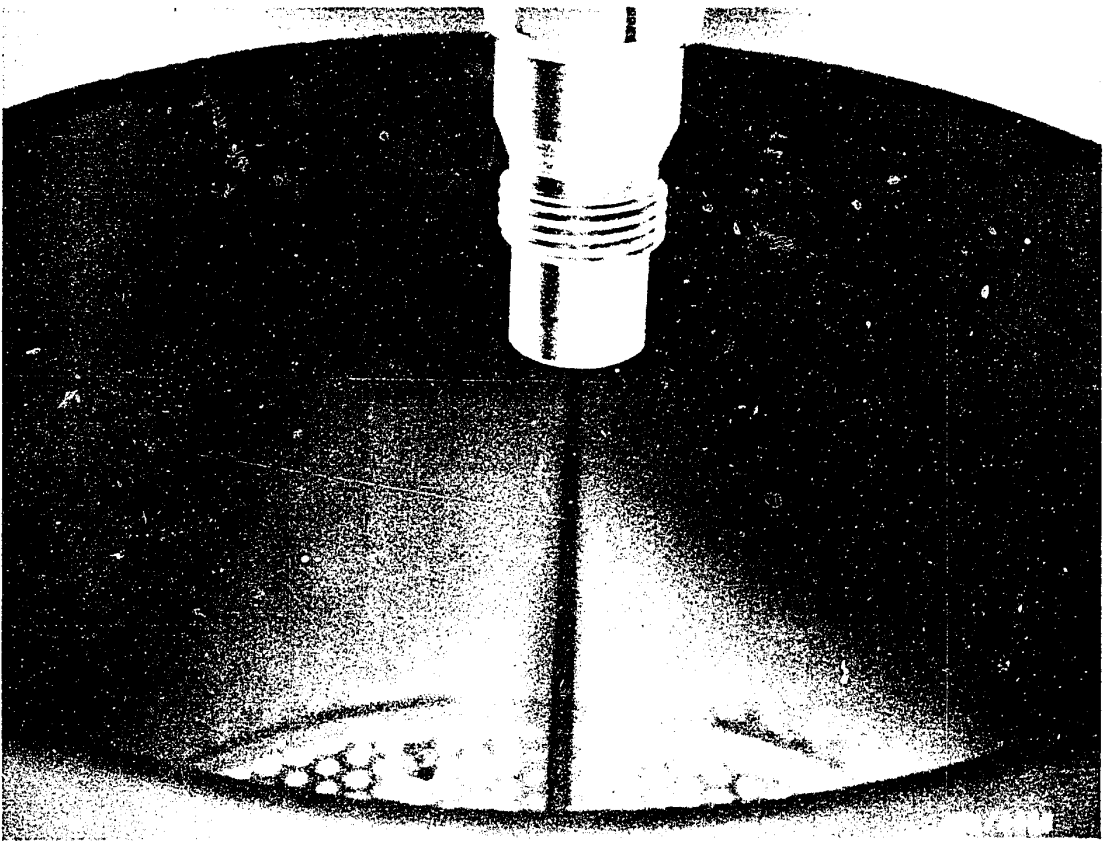
The test is run using nozzle tester EFEP 60 H  
0 681 200 502.

Put the fuel-injection nozzle and the nozzle holder  
assembly on the nozzle tester.

N.B.!

When testing the fuel-injection nozzles, make certain  
that the fuel jet does not strike your hands, because,  
due to the high pressure, the fuel penetrates into the  
skin and can cause blood poisoning.





### 22.1 Checking the jet

Turn off the pressure gauge.

Evaluation of the jet pattern is possible only with quick movements of the lever (approx. 4...6 strokes per second).

The jet must be fairly tight and must come out well.



## 22.2 Chatter test

The pressure gauge is disconnected.

Slowly press the lever of the tester down all the way (1 ... 2 strokes per second).

Nozzles in proper condition must chatter even if fuel comes out.

## 22.3 Checking ejection pressure

Turn on the pressure gauge.

Slowly press the lever down.

Measure the ejection pressure at the start of ejection.

If there are deviations from the specified value, the nozzle opening pressure must be corrected using shim discs behind the pressure spring in the nozzle holder assembly.

### Specified values

Induction engine: 130 + 8 bar

Turbo engine: 155 + 8 bar

Thicker shims = higher nozzle opening pressure

Thinner shims = lower nozzle opening pressure

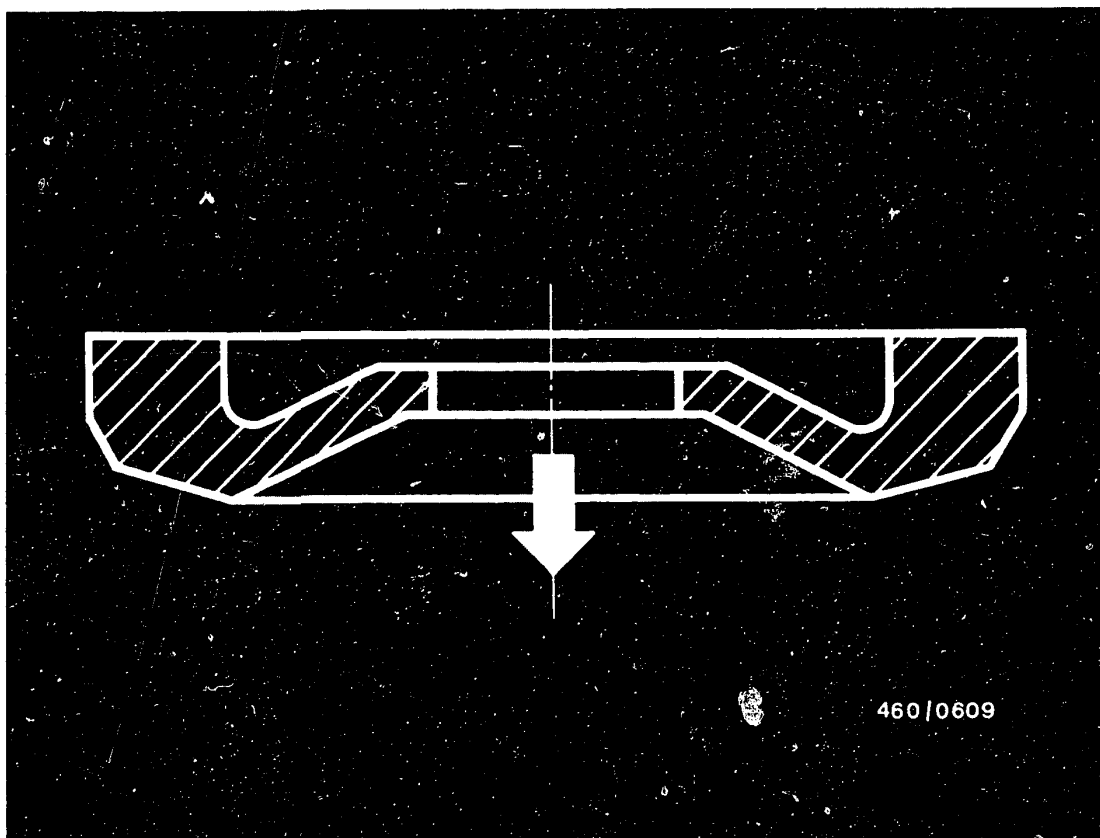
Reducing the spring travel by 0.05 mm increases the nozzle opening pressure by 5.0 bar.

## 22.4 Testing for leaks

Pressure gauge is turned on.

Slowly press the lever down and maintain a pressure of approx. 20 bar less than the opening pressure for 10 seconds. It is not permissible for a drop to fall from the nozzle when this is done.





### 22.5 Putting in the fuel-injection nozzles

Before installation of the fuel-injection nozzles, put in a new heat insulator disc in the cylinder head as a shield and lateral compensation for tolerances (sealing cone 150° in the direction of the arrow).

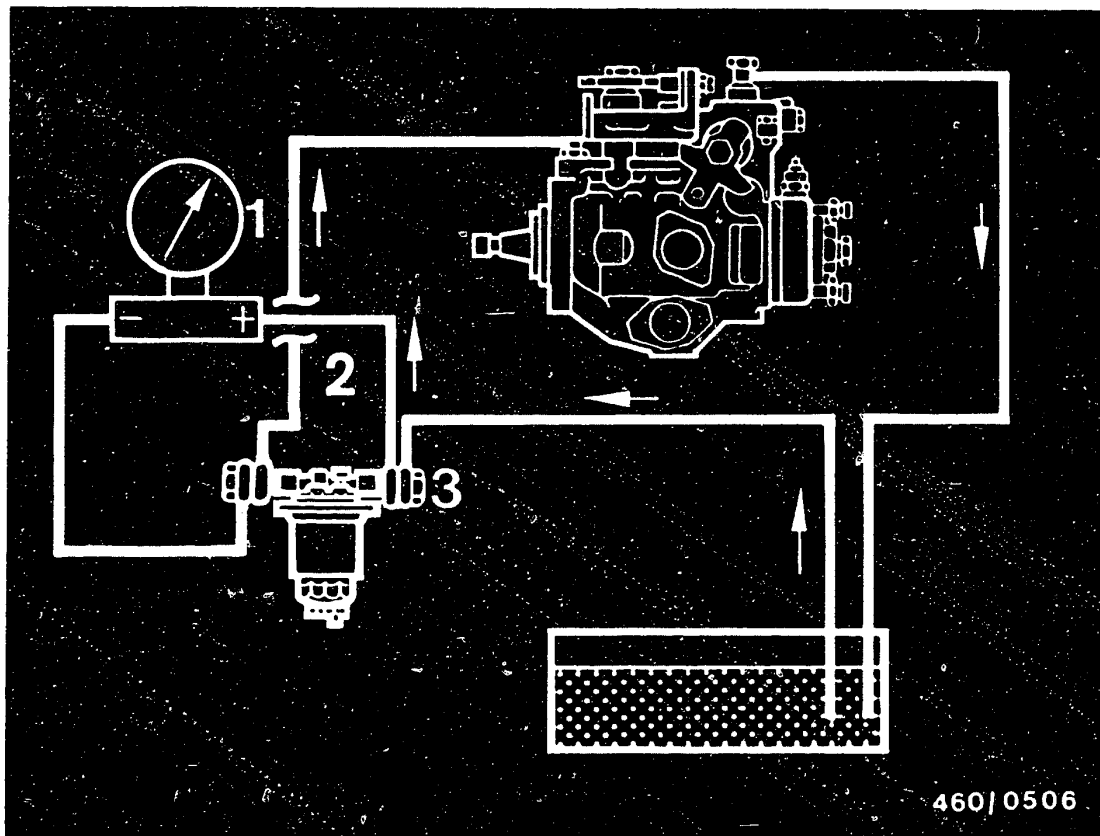
Then screw the nozzle holder into the cylinder head and tighten it to 70 Nm.

Note:

If the tightening torque is exceeded, the nozzle needle can jam.

Tighten union nuts on the supply lines to 25 Nm.





- 1 = Differential pressure gauge
- 2 = Filter drain  
(use inlet union and overlong inlet-union screw  
2 443 456 020)
- 3 = Filter inlet  
(use inlet union and overlong inlet-union screw  
2 443 456 020)

### 23. Checking fuel filter

Connect the differential pressure gauge to the fuel filter across appropriate connectors.





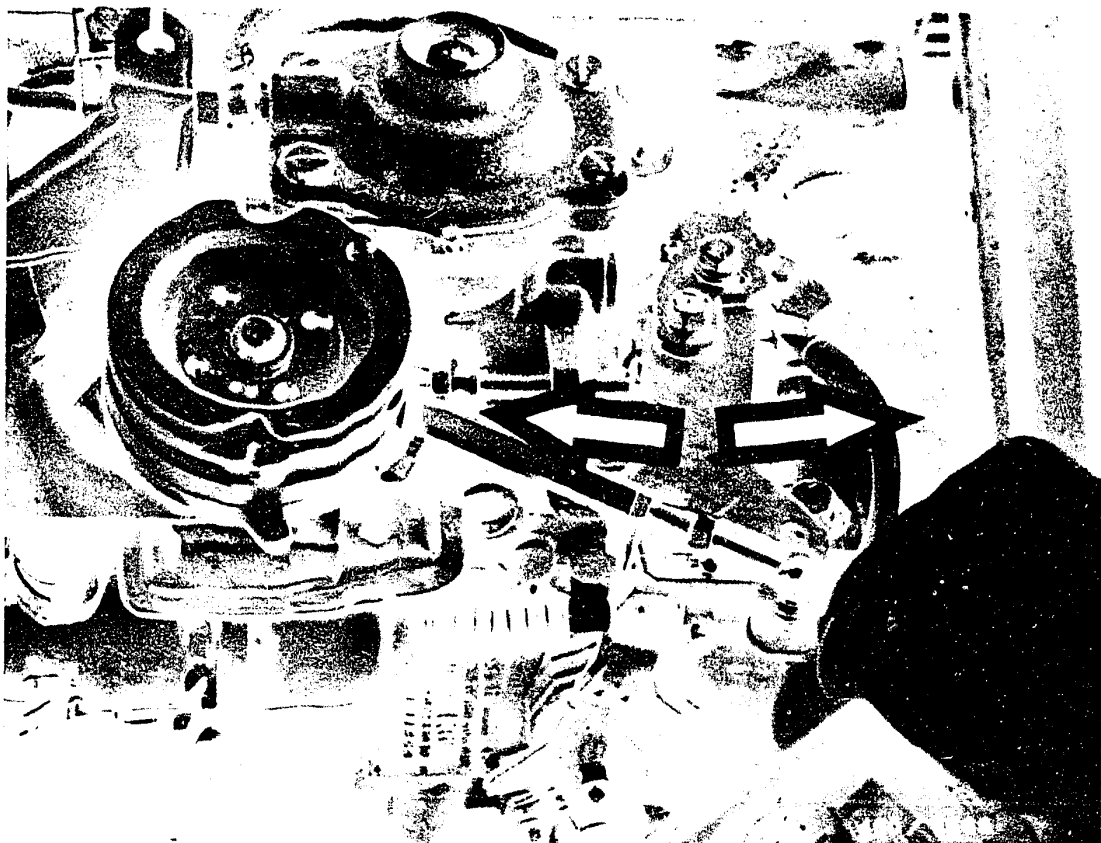
Connect the differential pressure gauge with the side marked (+) to the fuel filter inlet.

Put the (-) connection of the pressure gauge on the filter drain.

Follow the diagram for connections.

Run the engine until it is certain that there is no air in the fuel system.





Move the fuel-injection pump control lever in a single movement (approx. 1 second) from the idle stop to the maximum speed stop.

Release the control lever and read the differential pressure on the pressure gauge.

The differential pressure must not exceed 0.3 bar. If this value is exceeded, take out and replace the filter.

Remove the test connections.

If need be, bleed the fuel system.



## 24. Checking the preheater system

### 24.1 Test equipment required

VA tester                      e.g. ETT 011.00                      0 684 101 100

### 24.2 Instructions for workshop

We recommend taking out and replacing the R sheathed-element glow plugs every 45 000 km.

Note:

Incorrect adjustment of the start of fuel delivery can reduce the service life of the sheathed-element glow plugs considerably.

### 24.3 Preheating durations

How long the preheater system is turned on depends upon the ambient temperature.



## Rechecking the preheater system

The preheater system is turned on when the glow-plug and starter switch is in position II.

How long the preheater system is turned on depends upon the temperature of the coolant.

### Preheating times:

°C	Preheating duration (sec), approx.
- 20	45
0	25
+ 20	15
+ 50	0 (does not light)

The preheater system is in operation during the starting process.

If the starting motor is not activated after the control light goes out, the glow duration controller switches off automatically after approx. 10...25 sec.

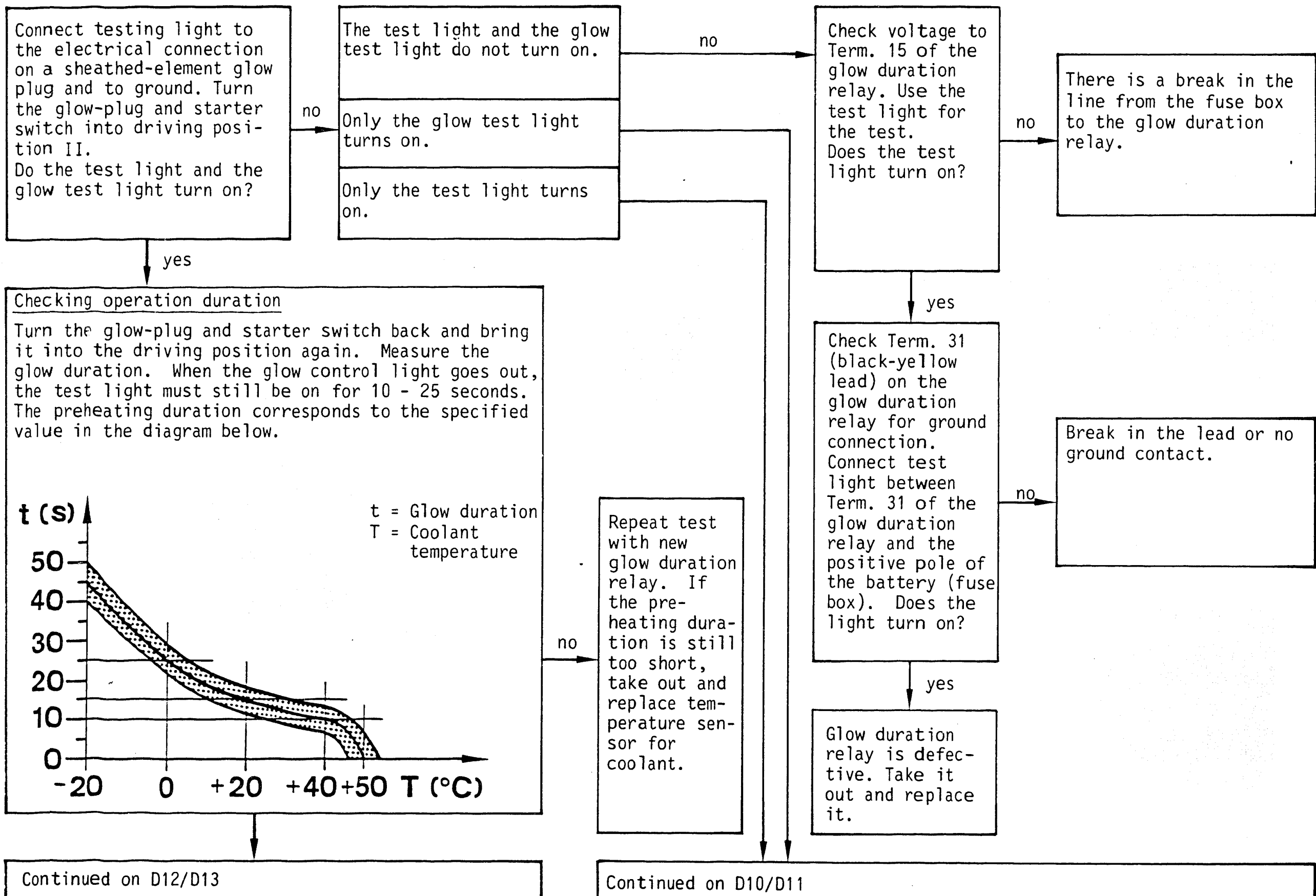
Between the glow duration controller and the power relay, there is a shutoff relay installed, which breaks the circuit as soon as the generator provides charging current. (Not in the 760 D Turbo).

Run the test with the engine cold, i.e. with a coolant temperature less than + 40°C.

Does the preheater system turn off automatically during the test?

Turn the starting key back into setting I for the glow-plug and starter switch. Then turn it back into the driving position.





**D8**

Checking the preheater system  
Volvo 240 D, 760 D-Turbo



**D9**

Checking the preheater system  
Volvo 240 D, 760 D-Turbo



Only the glow control light turns on

Check voltage at power relay Term. 86 (thin red lead). Connect the test light to Term. 86 of the relay and to ground. Does the test light turn on? (Not for the 760 D-Turbo).

no

Check voltage to Term. G of the glow duration relay (blue lead) Use test light for test. Does the test light turn on?

no

Glow duration relay is defective. Take it out and replace it.

yes

yes

Connect the test light between the ground connection terminal (black lead) and the positive pole of the battery. Does the test light turn on?

no

Ground lead damaged or poor ground contact

yes

Power relay defective. Take it out and replace it.

yes

Continued on D12/D13

Only the test light turns on

Check operation of the glow control light with the temperature sensor lead disconnected. The disconnected lead must not be grounded. Does the glow control light turn on?

no

Check Term. K (yellow lead) on the glow duration relay for grounding. Connect test light between Terminal K and positive pole of the battery (via fuse box). Does the test light turn on?

no

Repeat test with new glow duration relay because short-circuit due to a defective lead from the temperature sensor to the glow duration relay is possible.

yes

Glow control light defective, or connection from glow duration relay to glow control light is broken. Possibly the circuit board for the Combi-Instrument in the instrument panel is defective.

yes

Temperature sensor defective. Take it out and replace it.

**D10**

Checking the preheater system  
Volvo 240 D, 760 D-Turbo



**D11**

Checking the preheater system  
Volvo 240 D, 760 D-Turbo



Checking operation duration (continued) from D8/D9

Turn the glow-plug and starter switch to starting position. Does the test light turn on?

yes

Check the sheathed-element glow plugs. Put the glow-plug and starter switch in its initial position. Take out the bus-bar for the sheathed-element glow plugs. Connect the test light between the positive pole of the battery and the individual glow plugs one after another. Does the test light turn on?

yes

Sheathed-element glow plugs O.K.

no

Using the test light, determine whether there is voltage at Term. 50 of the glow duration relay (blue-yellow lead) during the starting process. Is there voltage there?

yes

Take out and replace the glow duration relay.

no

There is a break between the multiple plug and the glow duration relay. (The plug connection is located under the floor mat at the left bracket for the center console).

Only the glow control light turns on (continued) from D10/D11

Recheck the voltage at Term. 30 of the shutoff relay. Use test light for the test. Does the test light turn on? (Not for 760 D Turbo)

yes

Check the voltage at Term. 87 (red lead) of the shutoff relay. Use test light for test. Does the test light turn on?

yes

Connection from shutoff relay to power relay has a break.

no

The lead between the glow duration relay and the shutoff relay has a break.

no

Check the voltage at Term. 87 (red lead) of the shutoff relay. Use test light for test. Does the test light turn on?

yes

Connect test light between shutoff relay Term. 85 (red lead) and positive pole of battery (via fuse box). Does the test light turn on?

yes

The shutoff relay is defective. Take it out and replace it.

no

Check voltage at Term. 86 (blue-red lead). Use test light for test. Does the test light turn on?

There is a break in the connection between the fuse box and the shutoff relay.

There is a break in the connection from the shutoff relay to the combination tester. Possibly the circuit board in the instrument panel is defective.

D12

Checking the preheater system  
Volvo 240 D, 760 D-Turbo

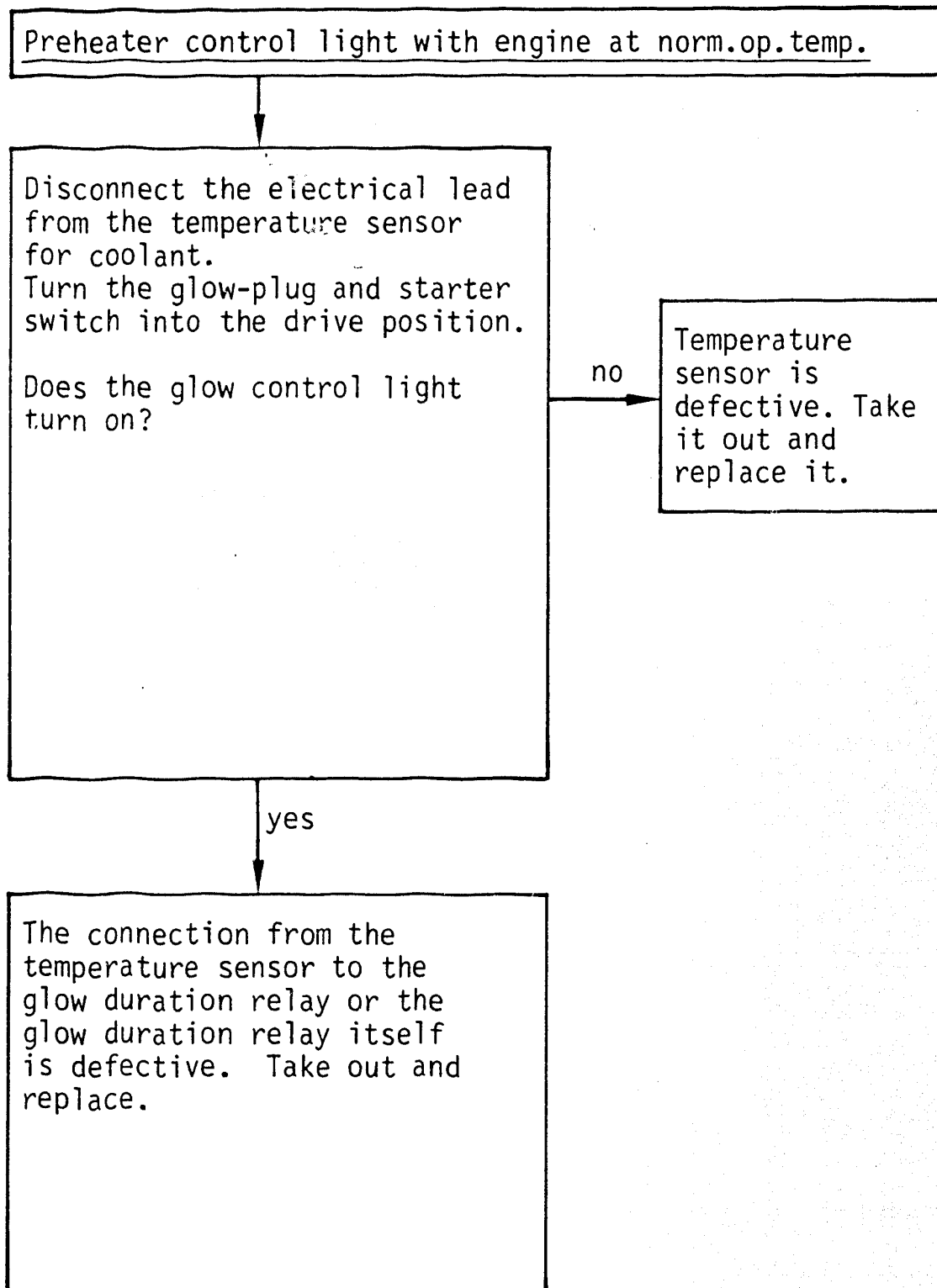


D13

Checking the preheater system  
Volvo 240 D, 760 D-Turbo

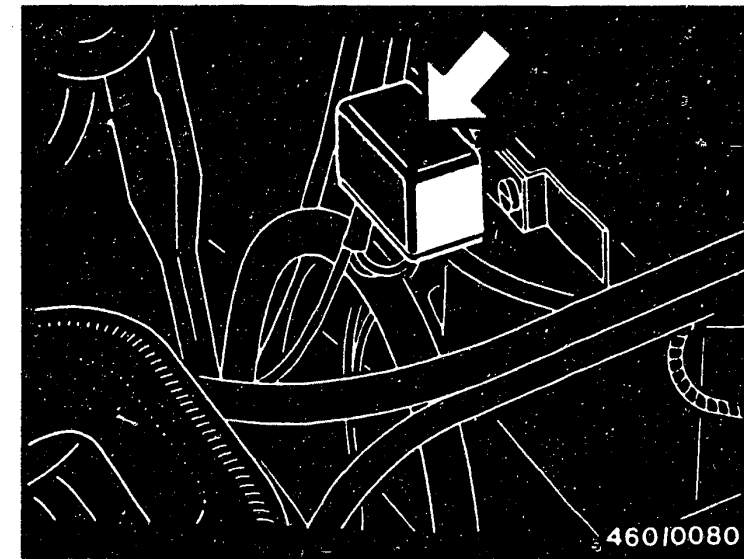




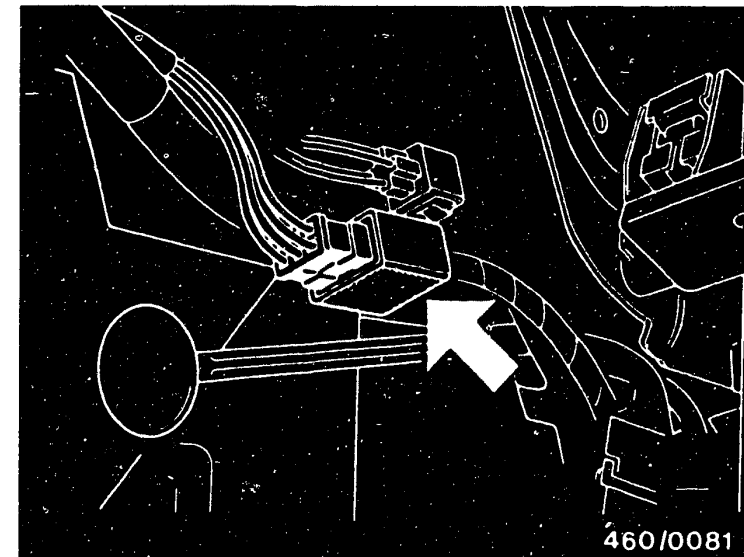


# Installation position of the relays

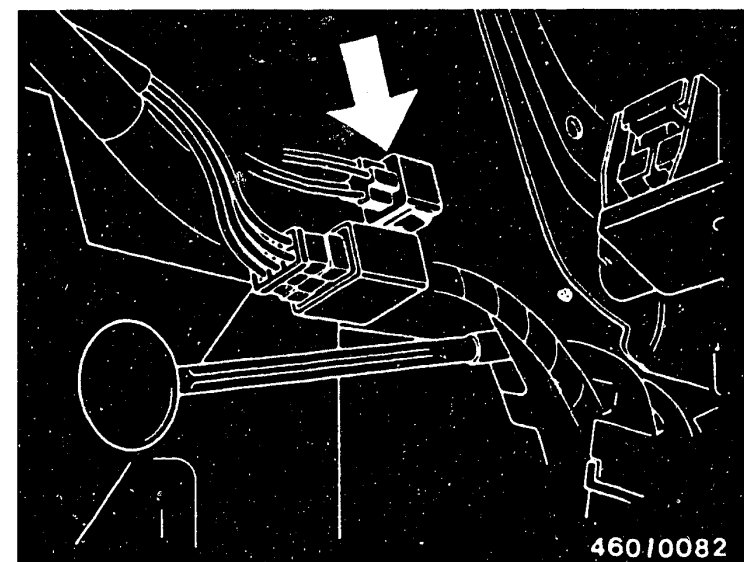
Power relay (arrow)  
240 D: On the left in the engine compartment



Glow duration relay (arrow)  
(240 D)



Shutoff relay (arrow)  
(240 D)



**D 14**

Checking the preheater system

Volvo 240 D, 760 D-Turbo

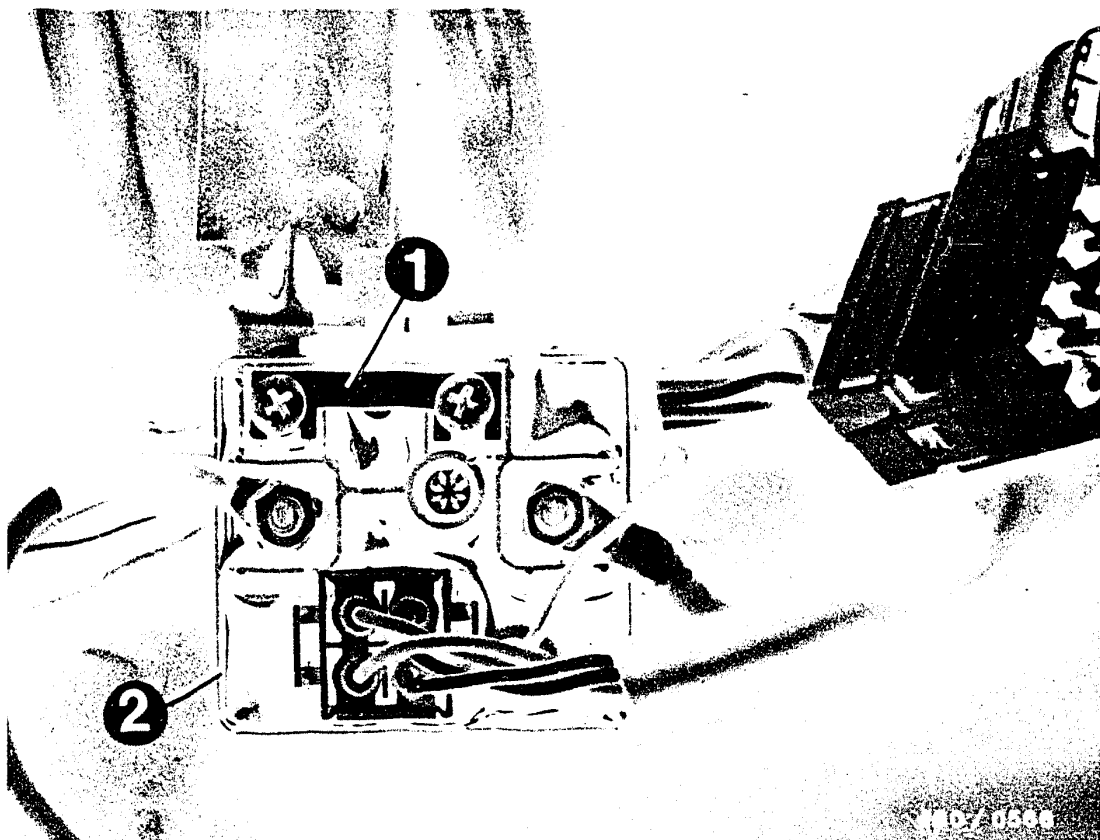


**D 15**

Checking the preheater system

Volvo 240 D, 760 D-Turbo





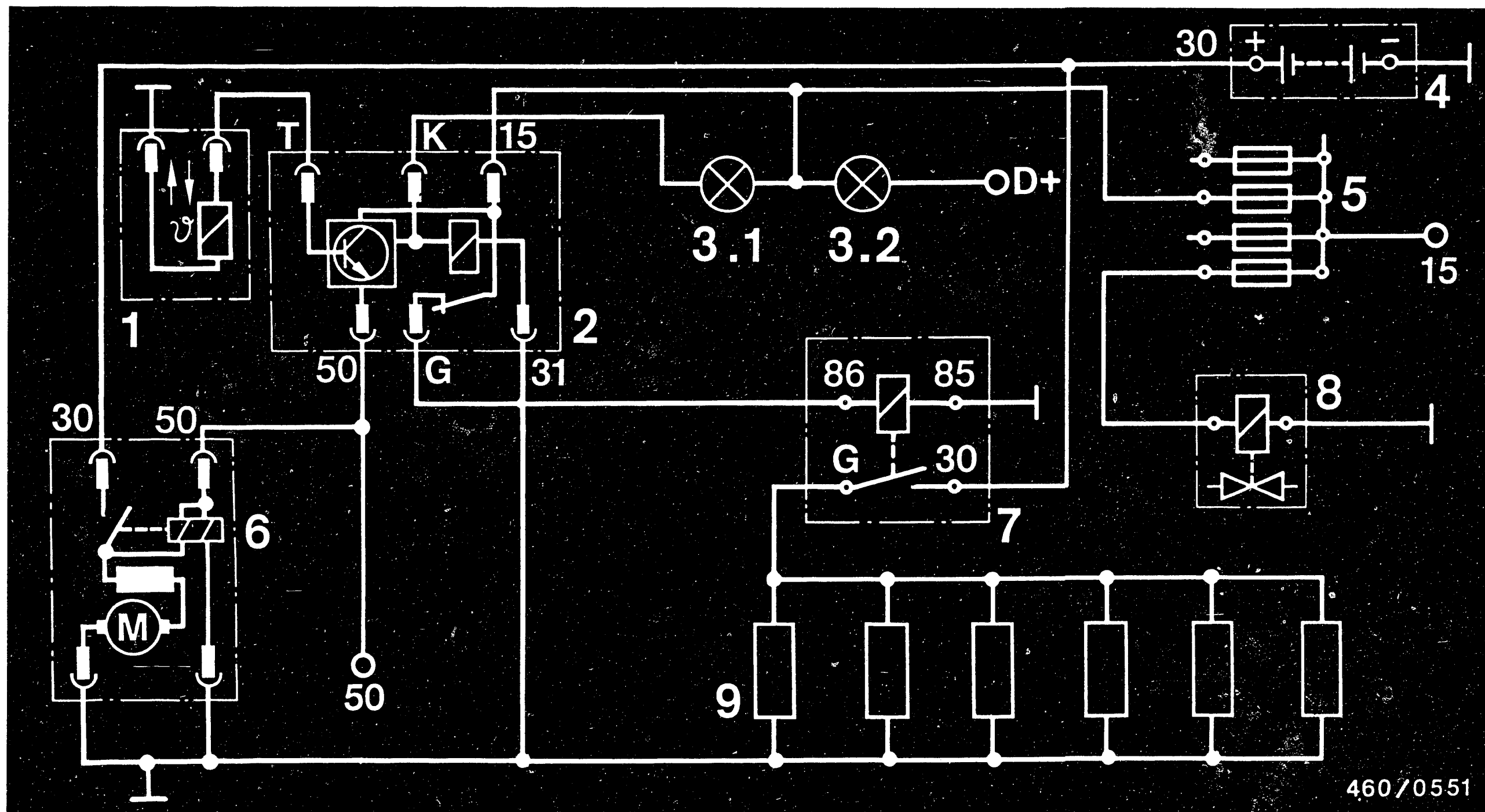
1 = 80 A fuse

2 = Glow duration controller

Installation position for the glow duration controller  
(760 D Turbo):

At the MacPherson strut mount at the left in the engine  
compartment.





1 = Temperature sensor  
2 = Glow duration controller

3.1 and 3.2 = Preheater control light  
4 = Battery

5 = Fuse terminal board  
6 = Starting motor

7 = Power relay  
8 = Solenoid valve  
9 = Glow plugs

Connection diagram for preheater system, Volvo 240 D (after 1981)

**D19**

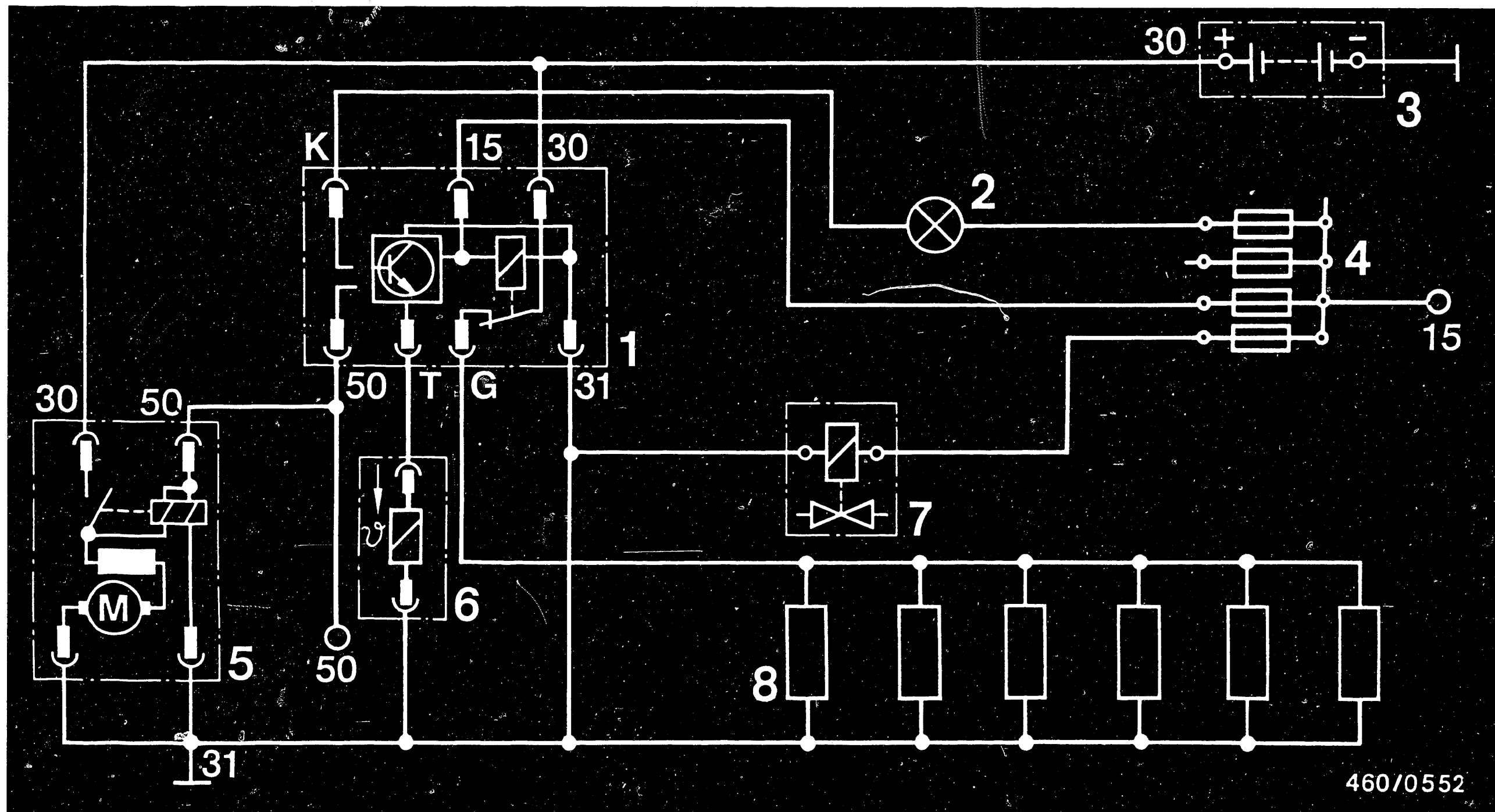
Checking the preheater system  
Volvo 240 D, 760 D-Turbo



**D20**

Checking the preheater system  
Volvo 240 D, 760 D-Turbo





1 = Glow duration controller  
2 = Preheater control light

3 = Battery  
4 = Fuse terminal board

5 = Starting motor  
6 = Temperature sensor

7 = Solenoid valve  
8 = Glow plugs

Connection diagram for preheater system (Volvo 760 D Turbo (after 8.82))

**D21**

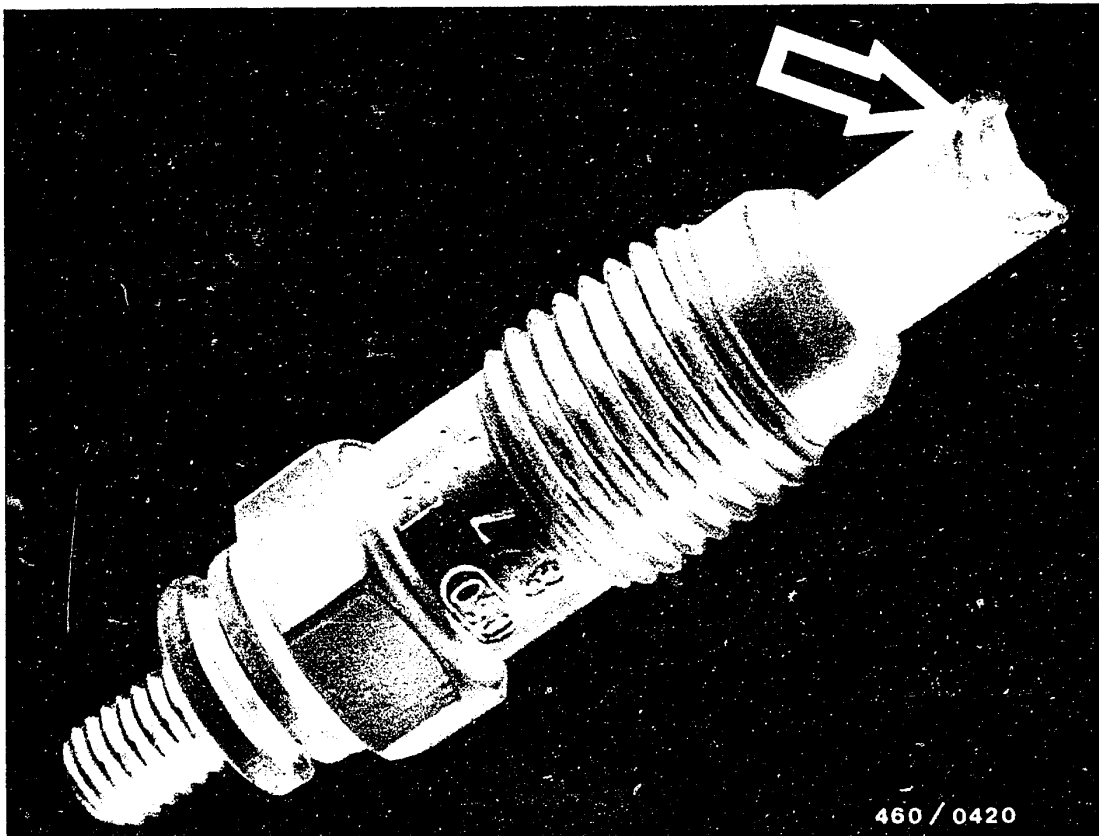
Checking the preheater system  
Volvo 240 D, 760 D-Turbo



**D22**

Checking the preheater system  
Volvo 240 D, 760 D-Turbo





Note:

Glow-plugs with burnt glow-pins

Glow plugs with burnt glow pins are frequently secondary damage following nozzle failures.

If glow plugs of this type are found when investigating a complaint (arrow) it is not sufficient merely to replace these plugs.

The fuel-injection nozzles must also be checked for the shape of the jet, chattering, pressure, and leaks.



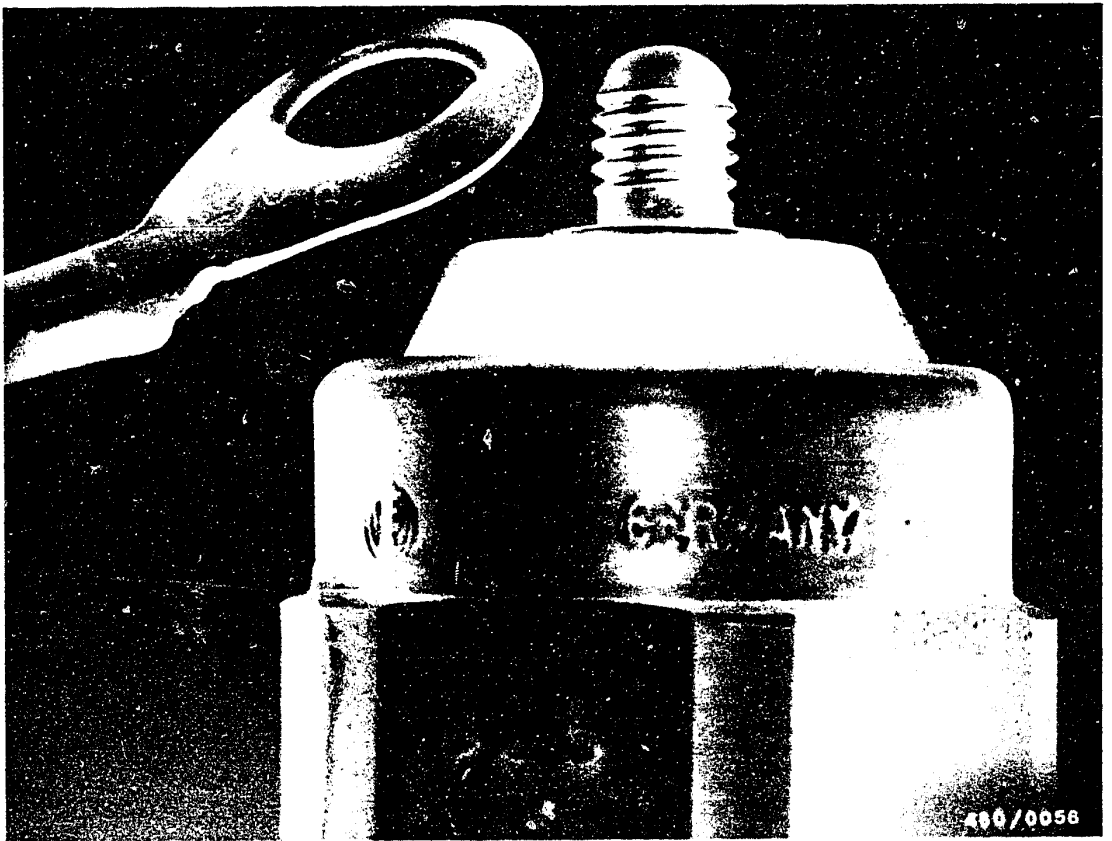
## 25. Checking the timing device

In the case of distributor-type fuel-injection pumps VE..F..., the timing device is integrated into the injection pump.

The fuel-injection pump must be taken out in order to test the timing device.

Testing is done on the fuel-injection pump test bench.





## 26. Measuring engine compression and pressure drop

### 26.1 Measuring engine compression

Put a new sheet of graph paper in the compression pressure recorder.

Connect the high pressure hose to the recorder.

Shut off the engine.

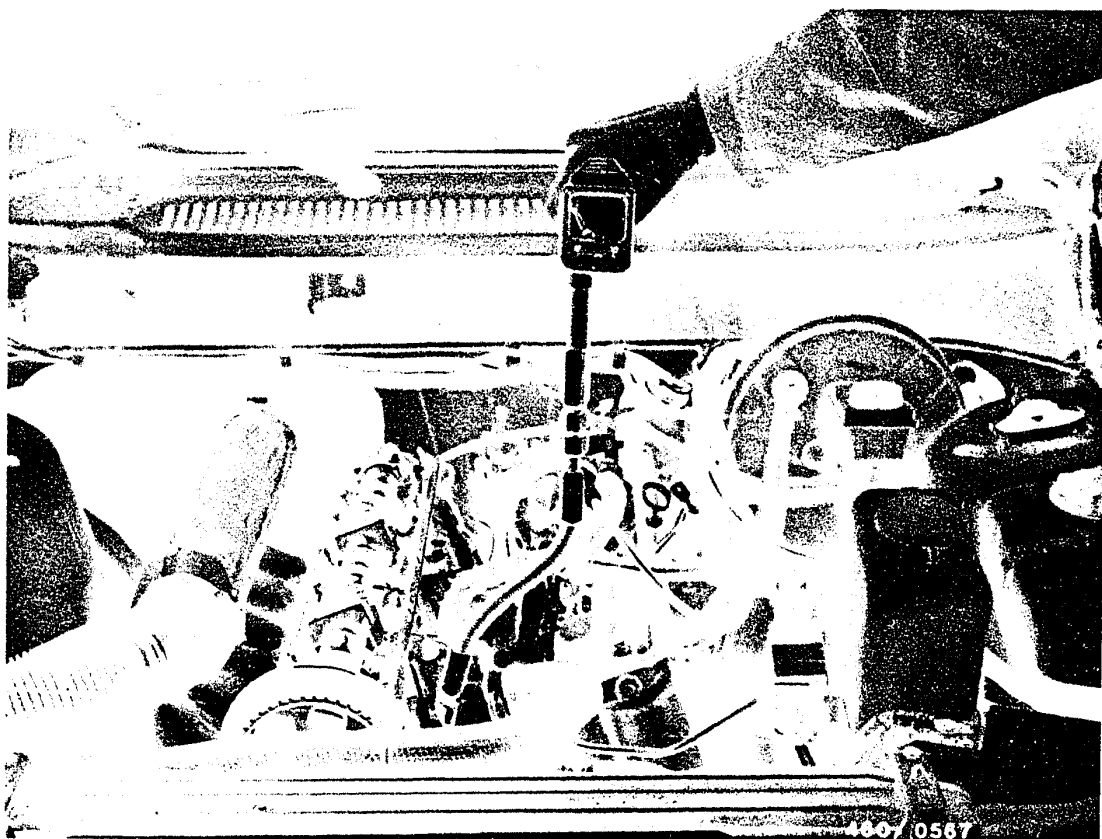
In order to avoid injection of fuel, remove the connecting cable on the shutoff solenoid for the distributor-type fuel-injection pump. (Figure)

**E1**

Measuring eng. compression and pres. drop  
Volvo 240 D, 760 D-Turbo







Screw out the nozzle holder assembly and use a suitable connecting fitting for the compression pressure gauge.

Turn the engine over several times using the starting motor, so that loose residues are removed from the compression chamber.

Screw in the connecting fitting.

Mount the high pressure hose of the compression pressure gauge on the connecting fitting.



During the following step, watch the first compression stroke.

Activate the starter until no further increase in pressure can be seen on the compression pressure recorder.

Bleed the compression pressure recorder by pressing on the bleeder valve.

The needle then returns to its initial position.

Bring the graph paper into its next position. Attach the connecting fitting to the cylinders that follow and repeat the measurement.

Test specifications:

<u>Type of engine</u>	<u>Compression pressure</u>	<u>Allowable cylinder deviation</u>
D 24	28 ... 34 bar	max. 5 bar
D 24 Turbo	24 ... 32 bar	max. 8 bar



## 26.2 Evaluation of the graph

### 1. Normal increase in pressure

If the piston rings and valves are in proper condition, the first compression stroke shows the highest increase in pressure.

During the additional compression strokes, the compression pressure builds up to maximum pressure.

### 2. Step-by-step increase in pressure

If the compression pressure from the start on increases only step-by-step per piston stroke, that means the valve seats are burned or the valve guides are inadequate.

### 3. Low maximum pressure

If the maximum compression pressure attained in all cylinders is too low, that indicates defective pistons, piston rings, or valves.

Too small a compression pressure at two neighboring cylinders indicates a leaking cylinder head gasket.



#### 4. Differing compression pressure

If one cylinder has a clearly lower compression pressure, proceed as follows.

Through the opening of the sheathed-element glow plug or of the nozzle holder assembly, put in 2 ... 3 cm<sup>3</sup> of motor oil and turn on the starting motor briefly.

Repeat the tests and compare the graphs. If the compression pressure in the second test is clearly higher, the piston rings or the cylinders are worn. If the results do not change, damaged valves are the cause.

#### 5. Uniform compression pressure

A uniform compression pressure is of the greatest significance for smooth operation of the engine. For that reason, do not strive merely for as high a compression pressure as possible.





### 26.3 Measuring engine pressure drop

Use Bosch Pressure Drop Tester 0 681 001 901 (EFAW 210 A) for testing.

For the test, the cylinder in question must be in the TDC position (TDC = top dead center) of the compression stroke.

To adjust this point, use the dead center locator 1 688 132 025 (contained among the accessories of the pressure drop tester).

Do the test with the engine at normal operating temperature (water temperature approx. +80°C).





#### 26.4 Adjusting the top dead center

Remove the sheathed-element glow plug of the first cylinder.

Insert the rubber plug of the dead center locator into the hole for the sheathed-element glow plug.

Attach the glass cylinder with the magnetic holder in as vertical a position as possible in the engine chamber (arrow).

The plunger on the instrument must be clearly visible.

Slowly turn the engine by hand in the direction of engine rotation. (If need be, put into gear, and move the vehicle).



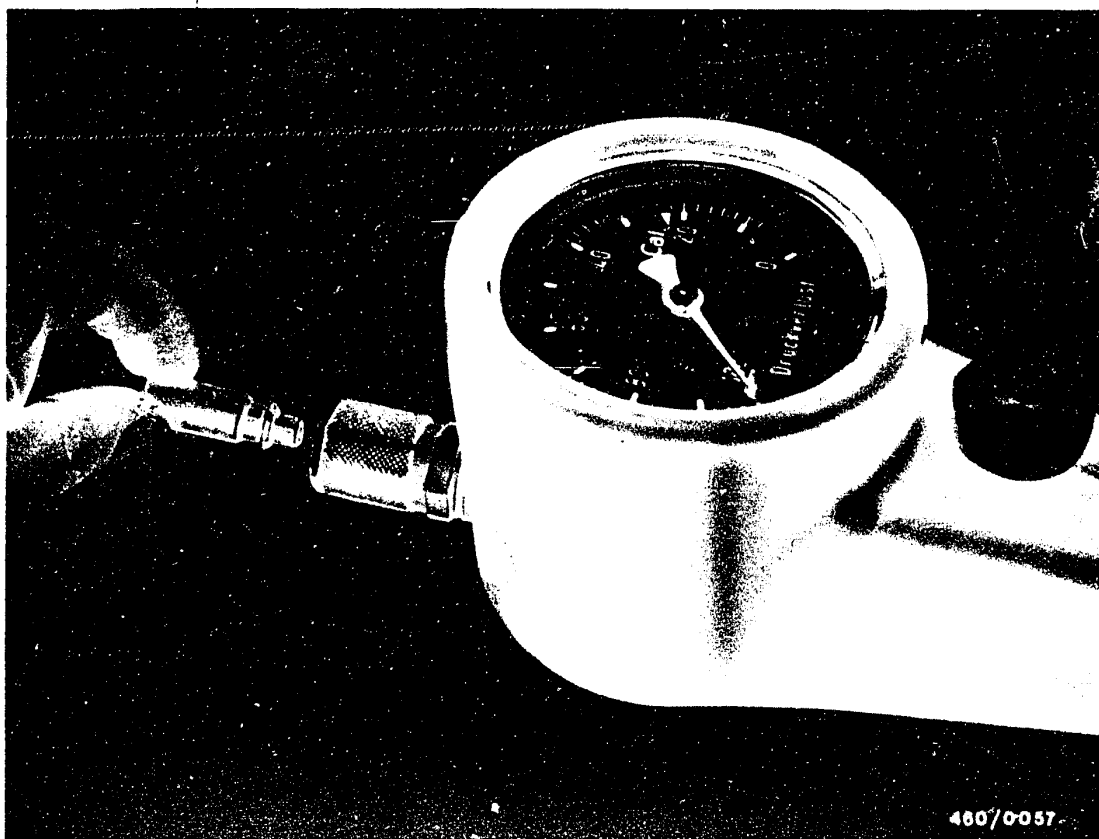


In the compression stroke, the plunger of the dead center locator is pressed upward.

When the top dead center is passed, the piston slides down immediately.

Find the dead center point by carefully turning the engine forward and backward.





### 26.5 Measuring pressure drop

Connect the tester to the compressed air system.

Connect test nozzle 1 680 363 036.

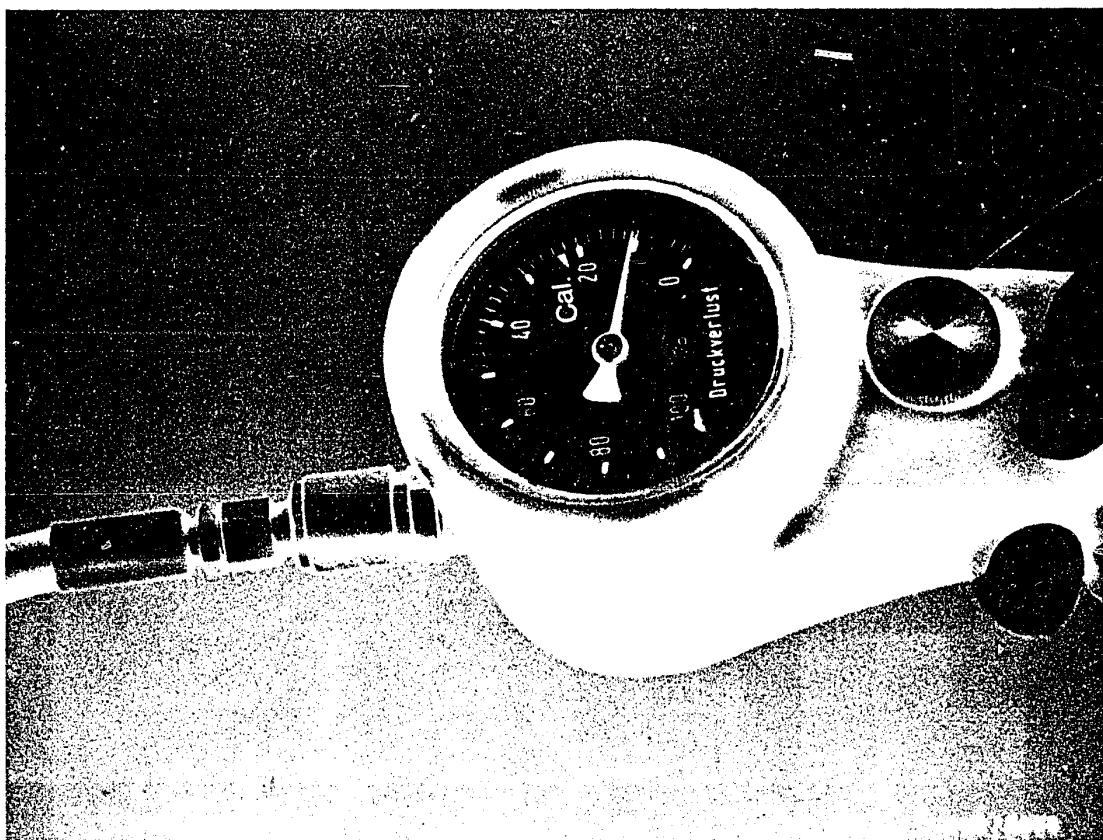
Using the knurled screw on the pressure control valve, set a pressure drop of  $23 \pm 1 \%$  (marking "Cal.").

Remove the test nozzle.

The needle on the measuring instrument must indicate approx. 0 % pressure drop - checking the instrument.







Screw in the connecting sleeve and put on the test hose.

Put into gear and put on the hand brake.

Connect the test hose to the tester.

Read the pressure drop in % on the instrument.

Note:

Before measurement on the next cylinder, run the engine briefly without preheating using the starting motor, so that the oil film forms again.



## 26.6 Evaluation of the test

The indicated pressure drop is not to exceed 25 %.

Differences between the individual cylinders of 10 % are meaningless.

If there are larger leaks, these can be localized, because the air makes a noise when it comes out.

Listen at following places:

<u>Locations of noise</u>	<u>Possible cause of problem</u>
Intake manifold (remove air filter)	Inlet valve
Exhaust manifold	Exhaust valve
Engine oil filling tube	Pistons, piston rings
Filling tube for coolant (air bubbles)	Cylinder head gasket

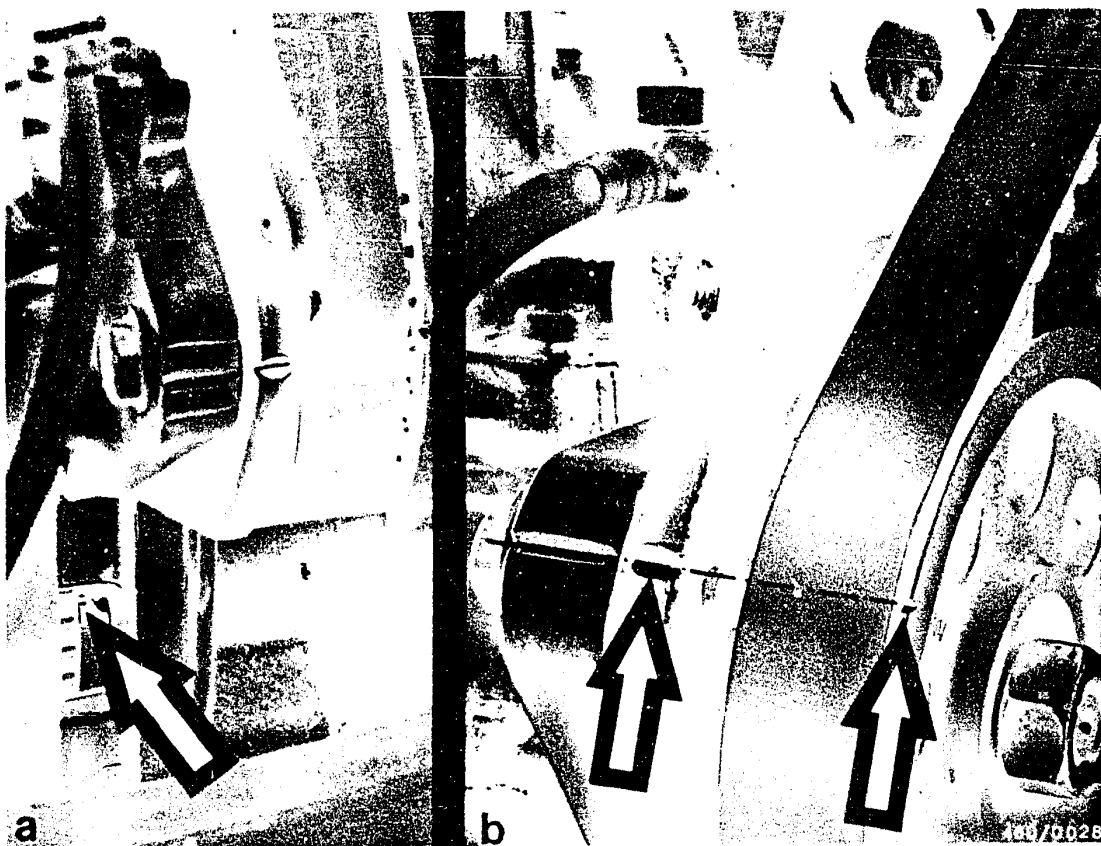
In order to make it easier to locate the source of the problem, put approx. 2 ... 3 cm<sup>3</sup> motor oil into the cylinder.

Repeat the test.

If the pressure drop is significantly lower in the test, the problem lies with the piston or with the piston rings.

Higher pressure drops are possible on new engines that have not yet been broken in (less than 5000 km) than after the break-in period.





## 27. Removal of fuel-injection pump

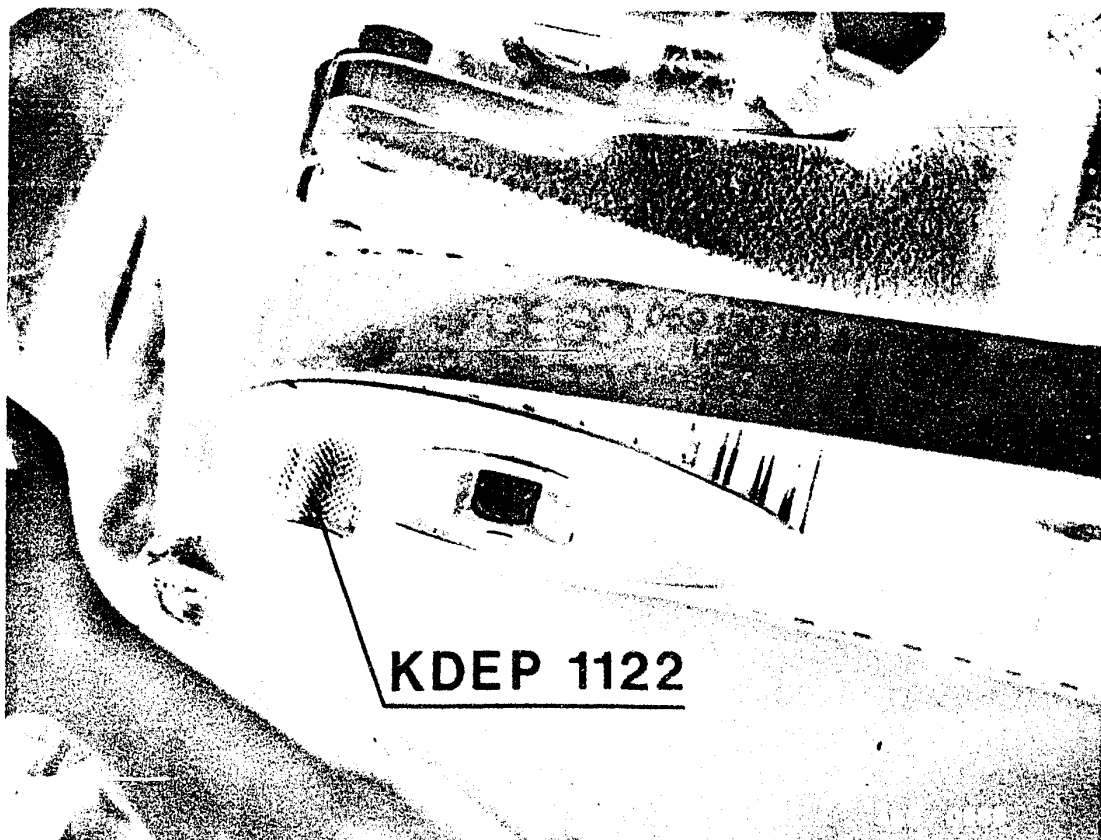
Disconnect the negative lead from the battery.

Remove the toothed-belt cover for the injection pump drive.

Turn the crankshaft to the first cylinder TDC.

The markings on the flywheel/coupling hood (Fig. a) and the fuel-injection pump gear/console (Fig. b) must align.



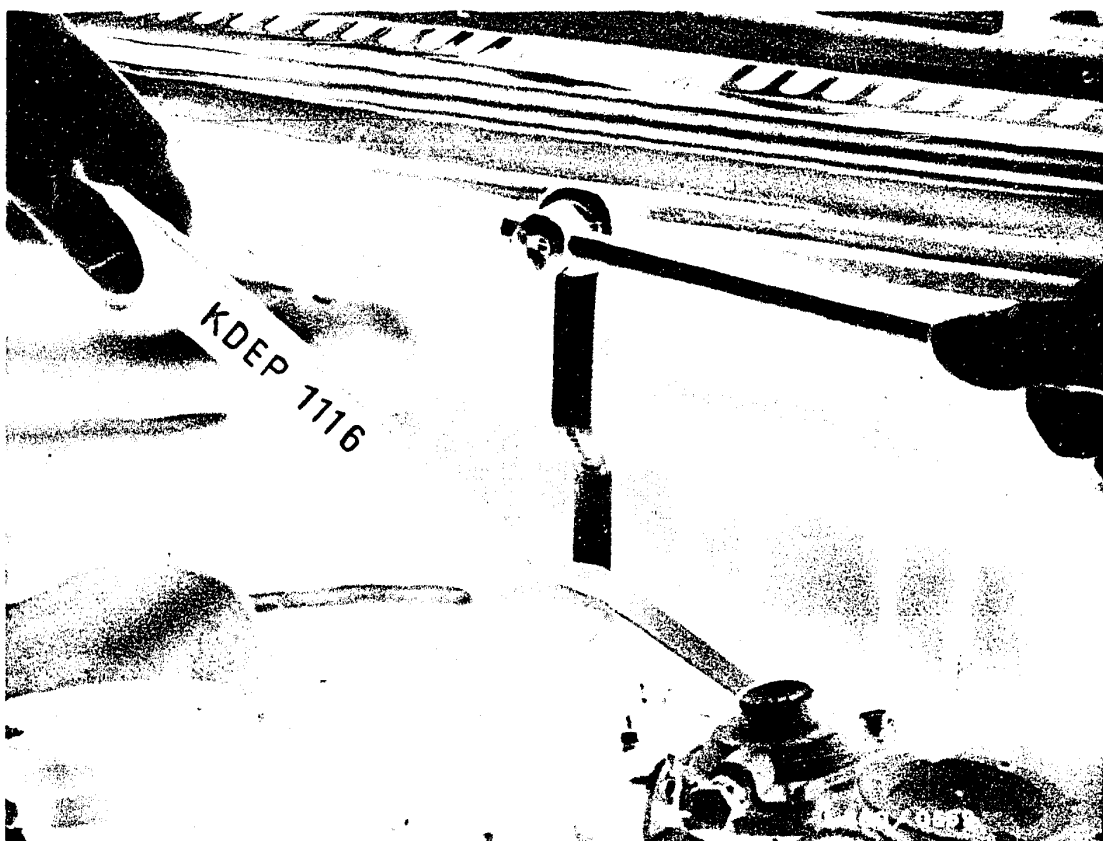


Fix the fuel-injection pump gear in place using locator mandrel KDEP 1122.

**E13**

Removal of fuel-injection pump  
Volvo 240 D, 760 D-Turbo



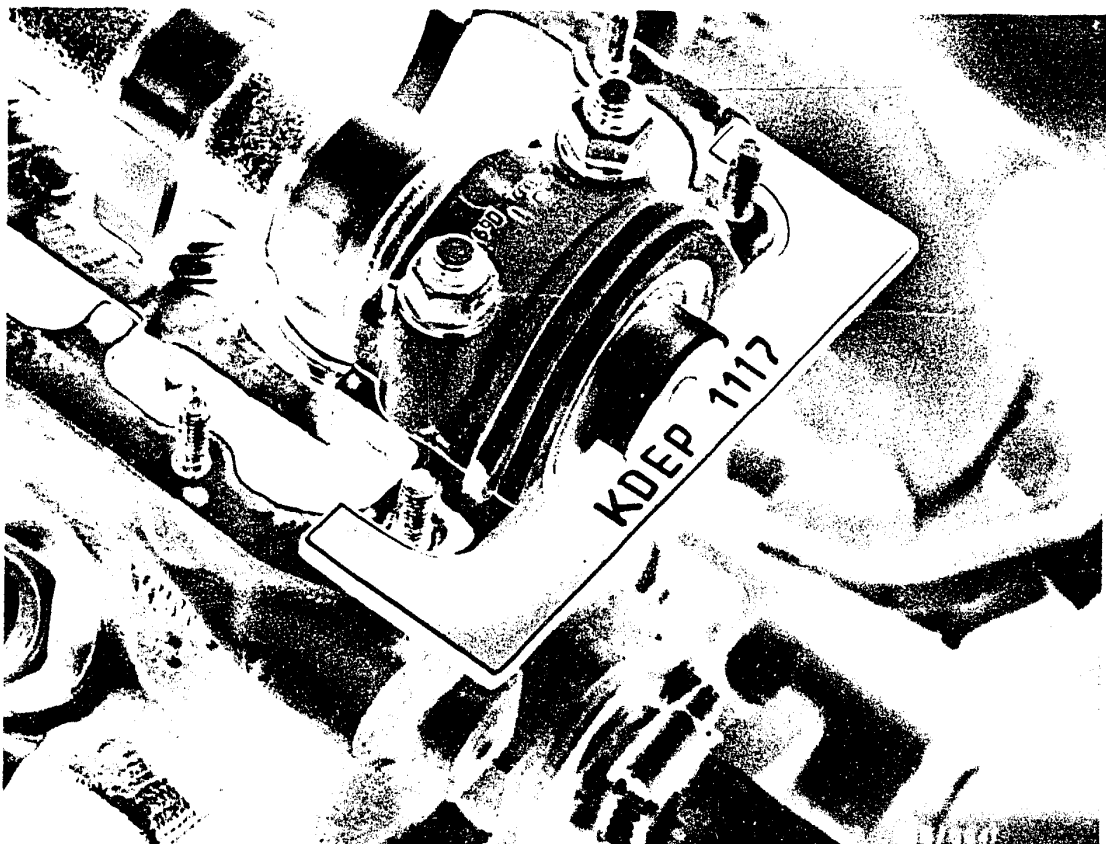


Hold camshaft gear in place using holding wrench KDEP 1116.

Release the fastening screw of the camshaft gear using box wrench KDEP 1120, and screw it out.

Remove the camshaft gear and the toothed belt from the camshaft of the engine.



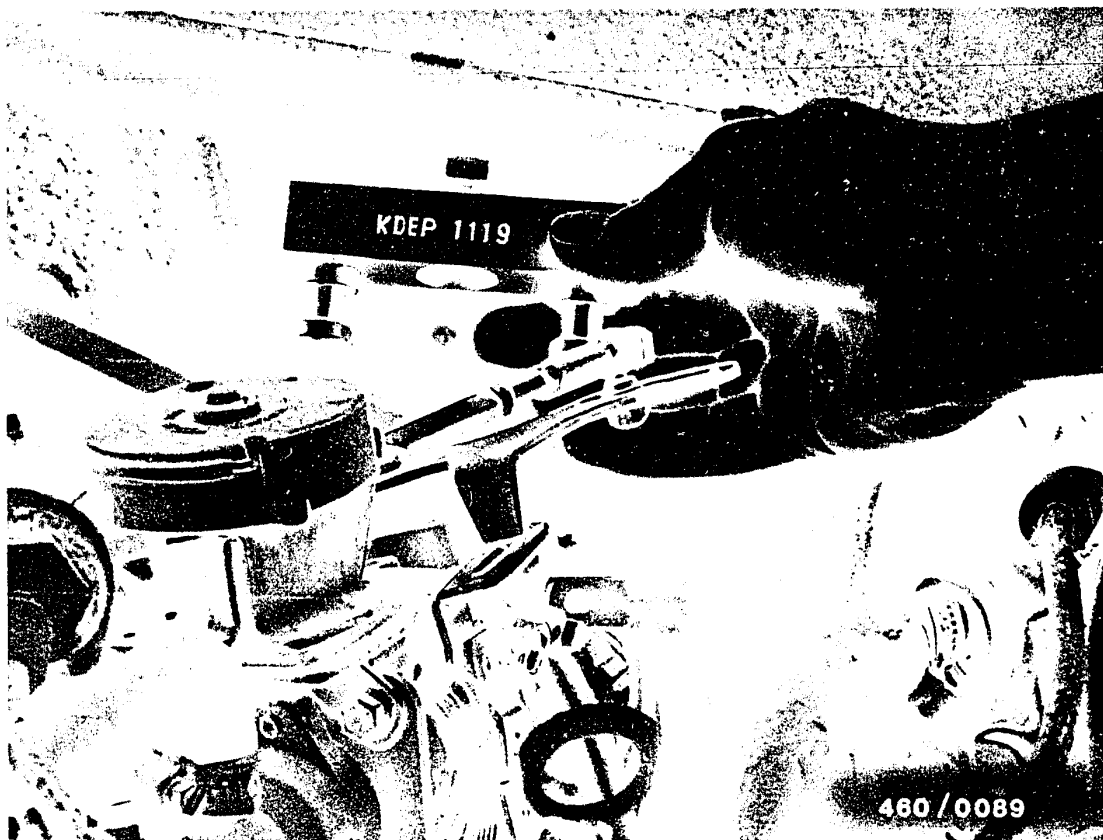


Take off the cylinder head cover.

Insert adjusting straight edge KDEP 1117 into the recess on the camshaft.

If the adjusting straight edge cannot be put in, correct the engine timing control.





Using box-wrench KDEP 1120, release the fastening screw of the fuel-injection pump gear by approx. 1/2 turn.

Mount extraction tool KDEP 1119 on the fuel-injection pump gear.

Pull off the fuel-injection pump gear.

Remove extractor KDEP 1119.

Unscrew the fastening nut and take off the fuel-injection pump gear with the locating mandrel.





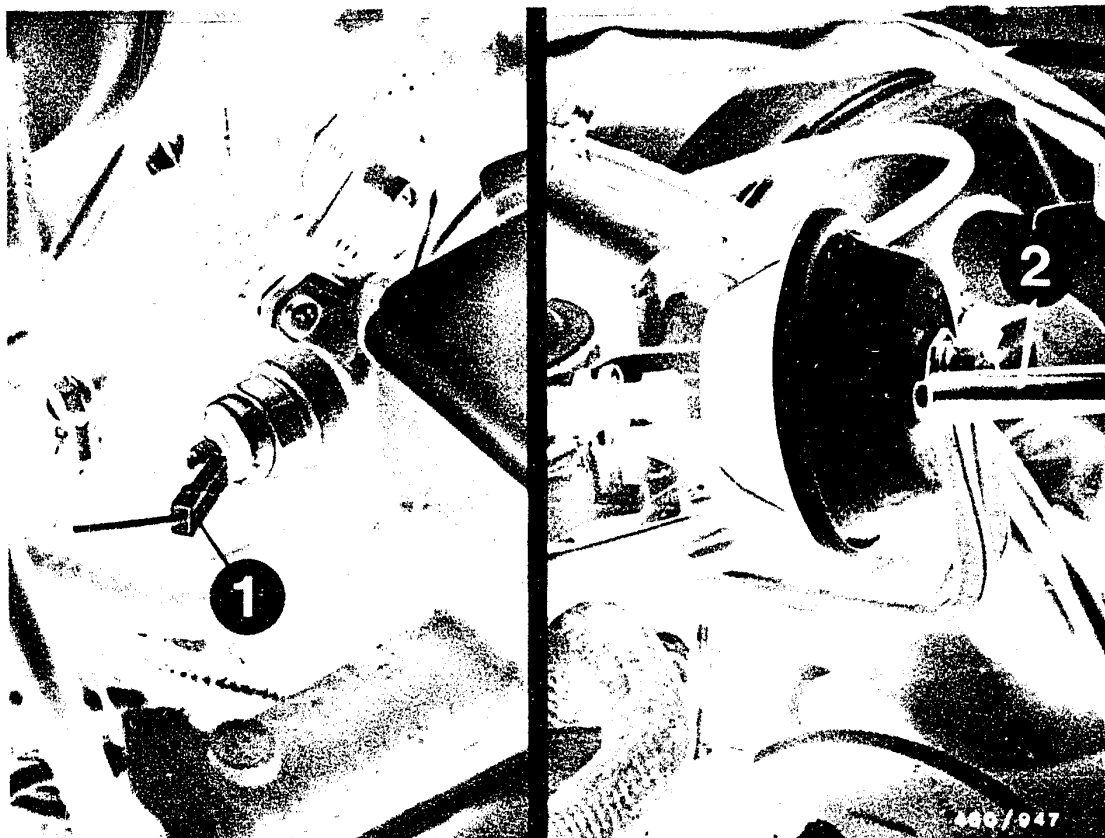
Release the fuel injection lines with an open box wrench KDEP 1115. (Keep the pressure valve holder from becoming loose by holding it with a wrench.)

**E17**

Removal of fuel-injection pump  
Volvo 240 D, 760 D-Turbo

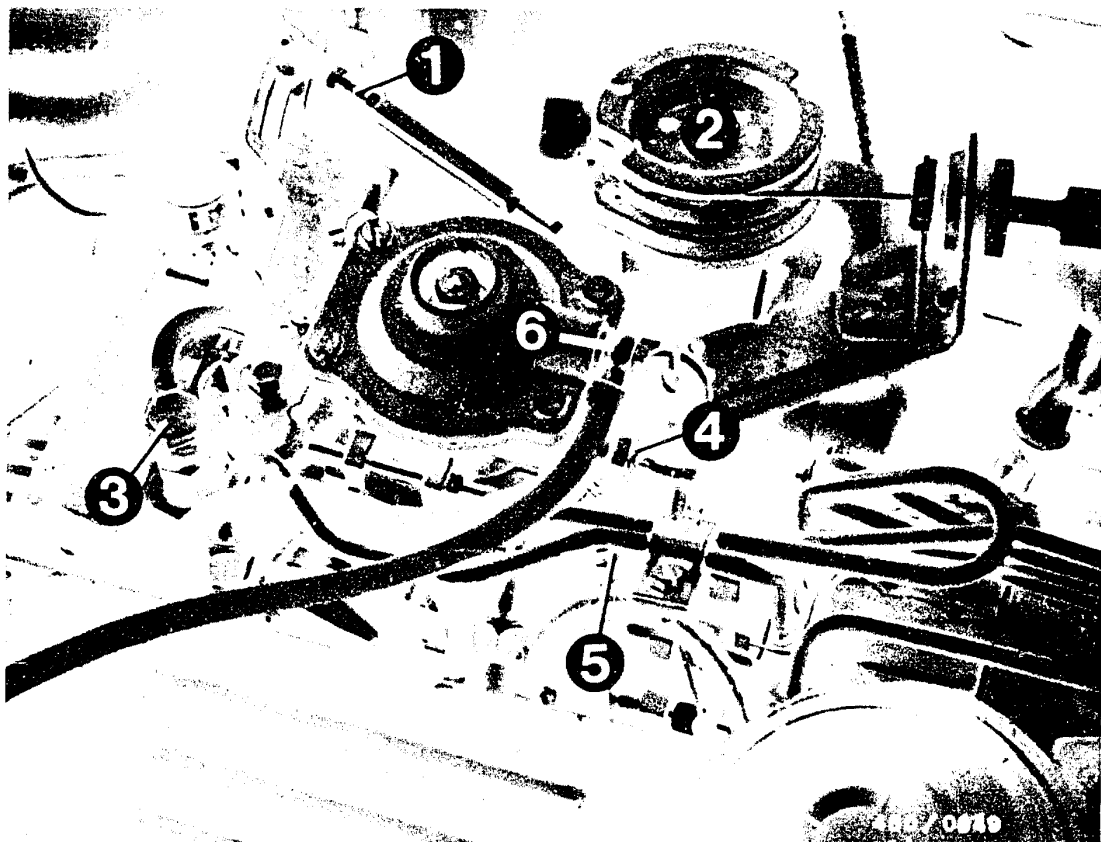






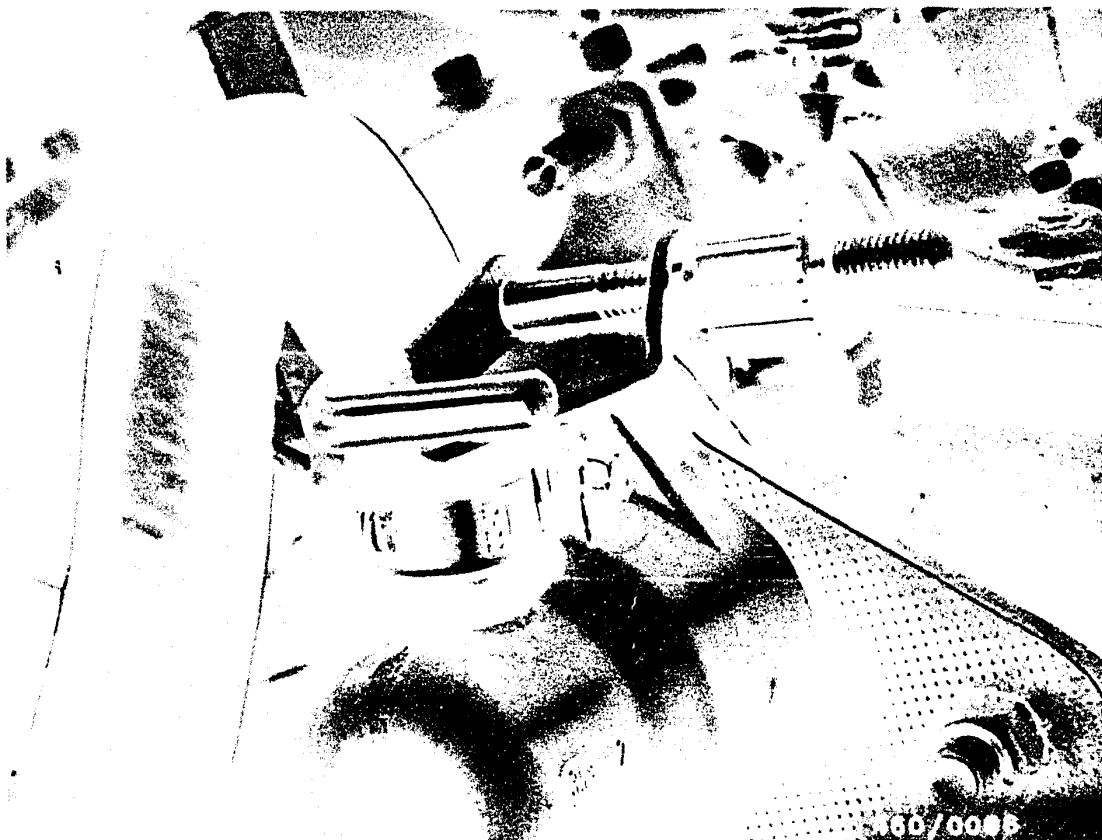
Disconnect the lead to the solenoid valve (1) and the line to the vacuum hose (2). (Only for vehicles with cruise control).





Remove the connector between the guide roller and the control lever (1), the guide roller, with the holder for the cable (2), the fuel inlet line (3), the return line (4), the lead for the electrical shutoff device (5), and the charge air pressure connection (6).





Using commercially-available crimping tools, unclamp the cooling water hoses just behind the control device for the fuel-injection pump.

Release the hose clamps and take off the cooling water hoses.

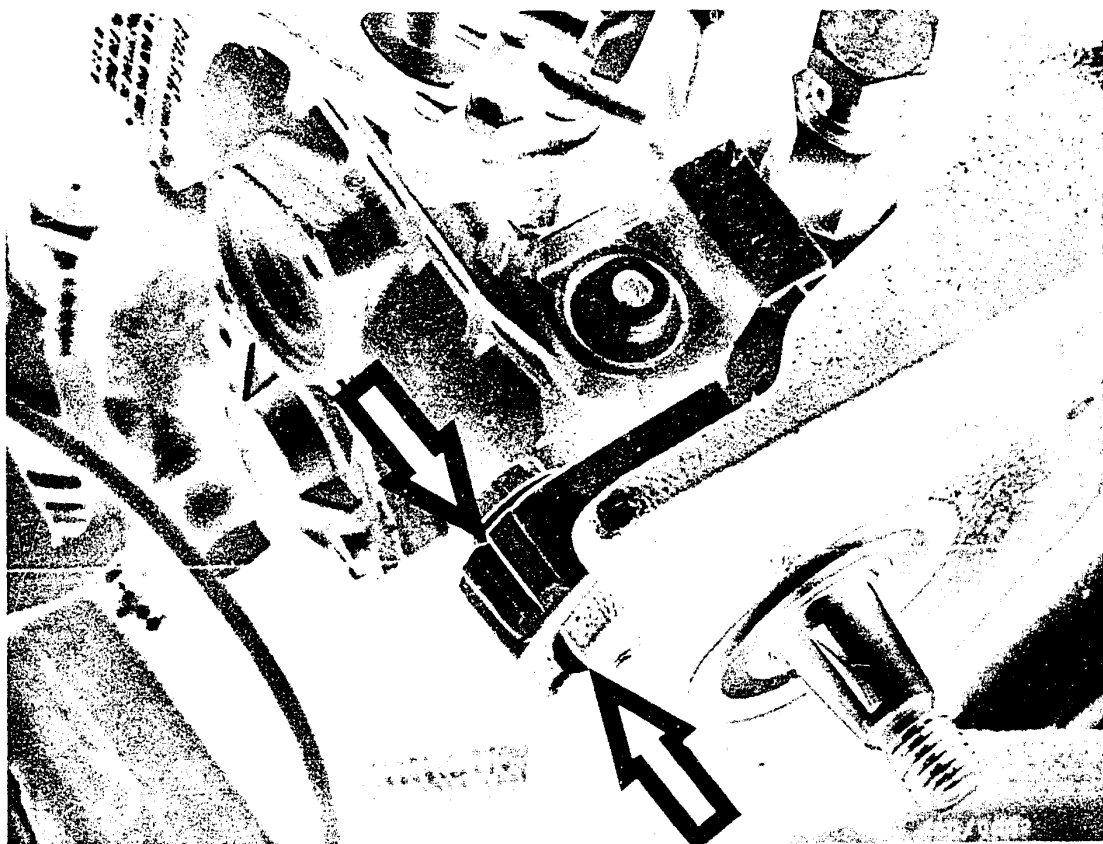




For the fastening screw at the back of the fuel-injection pump, use a socket wrench insert 220 mm long for a 6 mm socket hex.

Remove other fastening screws and take off the distributor-type fuel-injection pump.





### 28. Putting in the fuel-injection pump

Set the fuel-injection pump in place in such a way that the markings on the fuel-injection pump flange and the console line up (arrows).

Put on the fastening screws for the fuel-injection pump and hand-tighten them.





Align the angle bracket on the hydraulic head of the fuel-injection pump in such a way that it touches without stress against the cylinder block and the hydraulic head.

Screw the support bracket on tight (arrow).

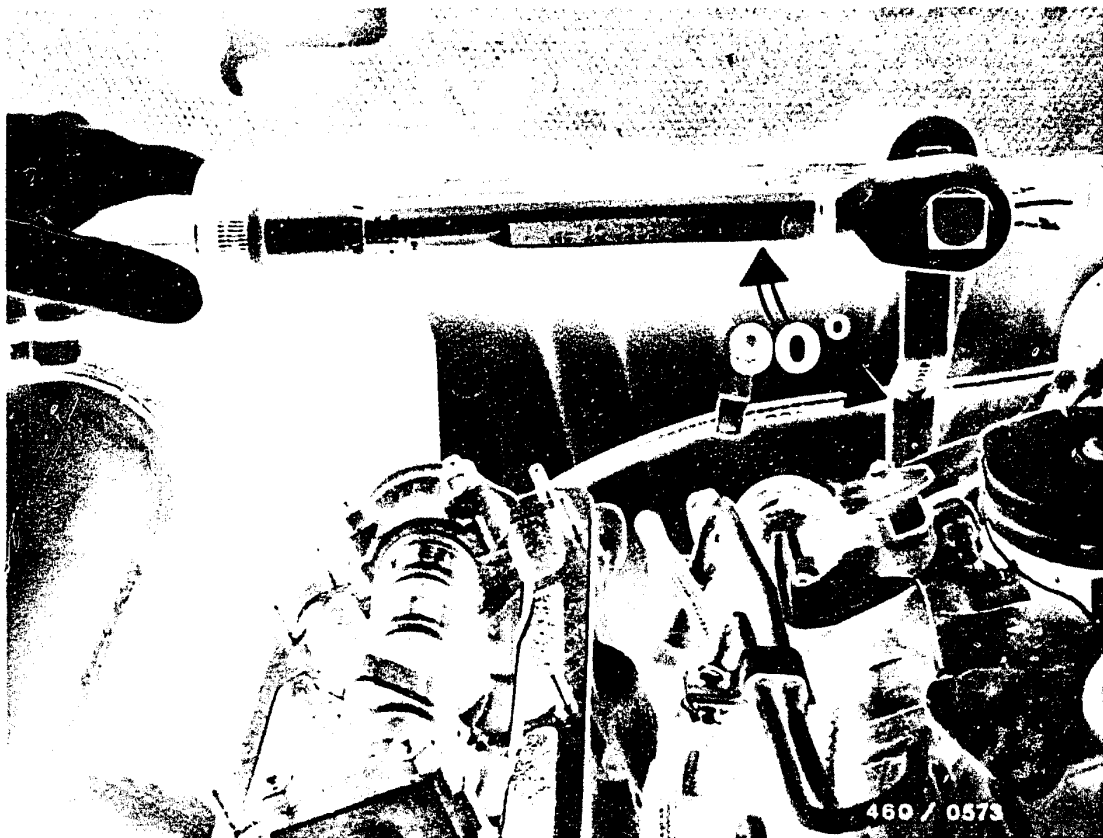




Put on the fuel-injection pump gear and turn it so that the notch marking on the fuel-injection pump gear and the console line up (arrows).

Fix the fuel-injection pump gear in place using locator mandrel KDEP 1122.





Using box wrench KDEP 1120, tighten the fastening nut of the fuel-injection pump gear to 45 Nm.

N.B.!

Insert the torque wrench into the box wrench in such a way that the box wrench and the torque wrench are exactly at right angles to one another.

If that is not the case, the tightening torque is not indicated correctly.

**F1**

Installation of the fuel-injection pump  
Volvo 240 D, 760 D-Turbo







Remove adjusting straight edge KDEP 1117.

Put on the cylinder head cover.





Put on the toothed belt and the camshaft gear of the engine.

Tighten the fastening screw for the camshaft gear only so far that it is still possible to move the camshaft gear by hand.

Remove locator mandrel KDEP 1122.

**F3**

Installation of the fuel-injection pump  
Volvo 240 D, 760 D-Turbo





Check the toothed-belt tension using the belt tension tester KDEP 1121:

Put on the belt tension tester as shown in the picture.

Turn the vernier casing until the lower edge of the casing coincides with the line marking on the measuring leaf.

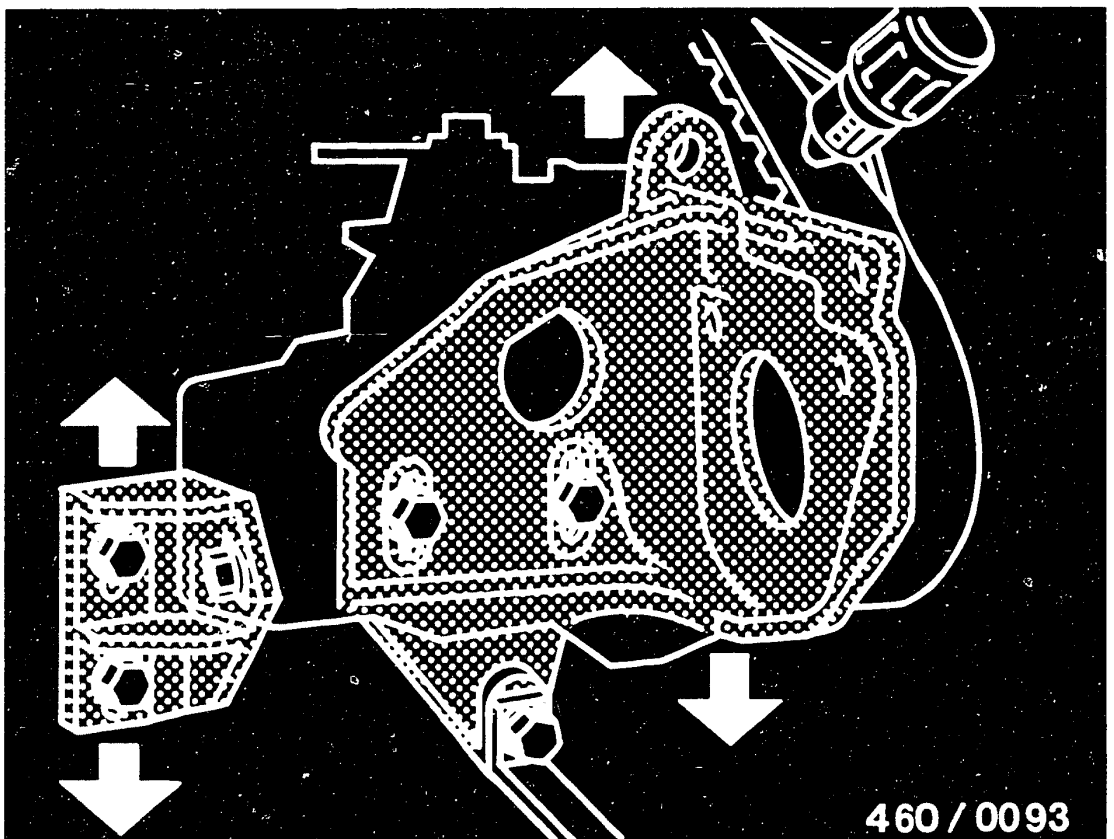
Take the measurement:

Specified measurement: Scale value 12 ... 13

**F4**

Installation of the fuel-injection pump  
Volvo 240 D, 760 D-Turbo



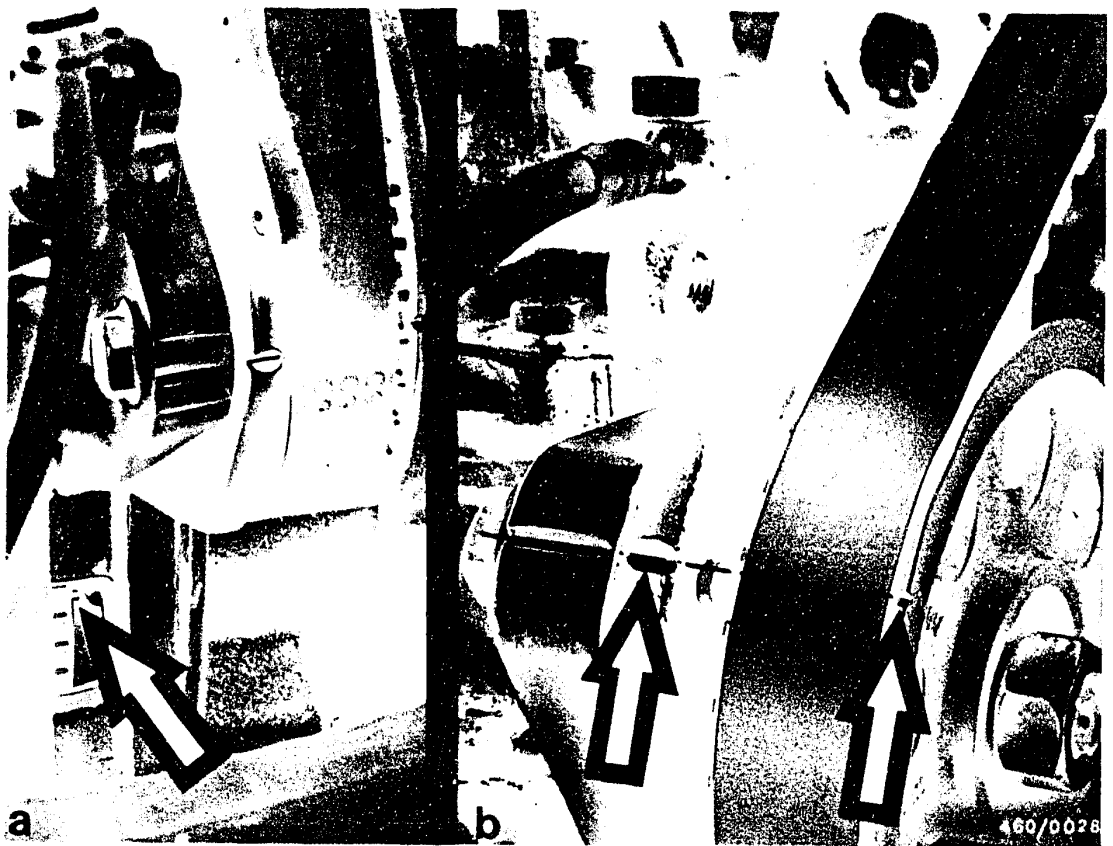


If the actual dimension deviates from the specified value, release the fastening screws on the pump console and the holding bracket on the hydraulic head.

Shove the fuel-injection pump and the console upward or downward accordingly (arrows).

Tighten the fastening screws for the pump console and the holding bracket to 65 Nm.

Turn the engine crankshaft twice and check the belt tensioning again.



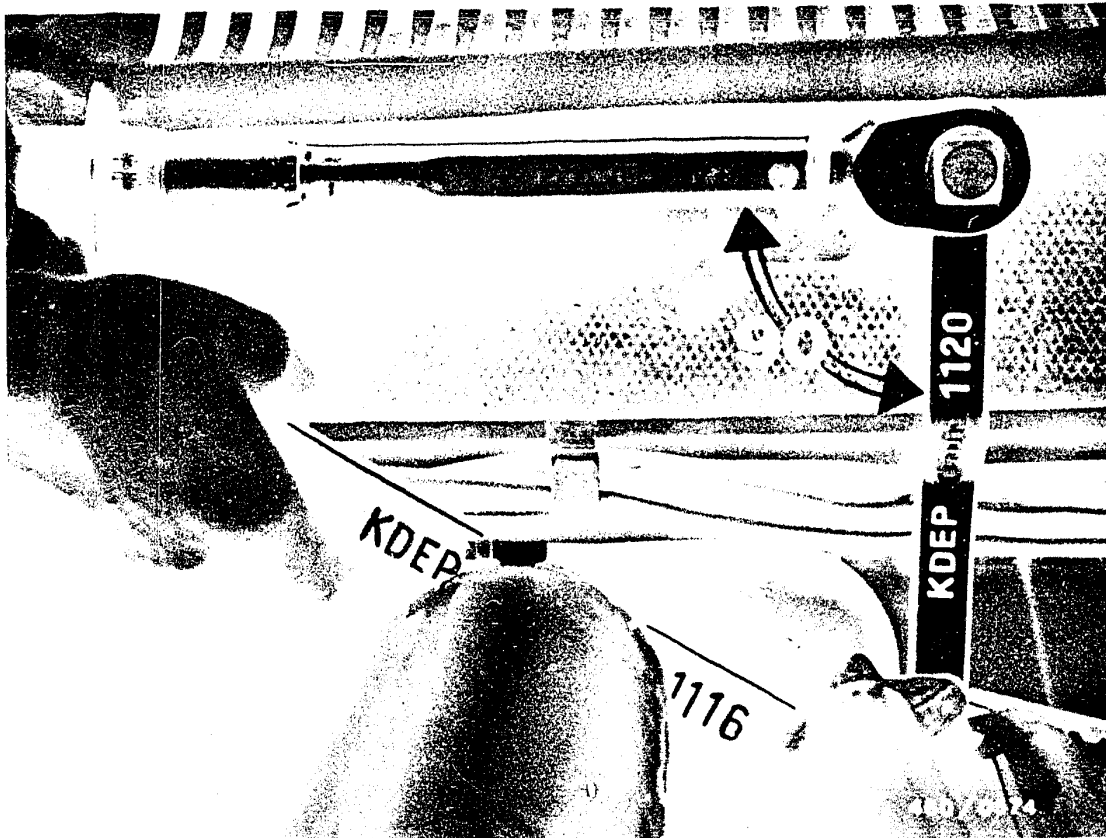
Check that the marking between the flywheel and the coupling hood, and between the fuel-injection pump gear and the console line up with the reference mark.

Fix the fuel-injection pump gear in place using locator mandrel KDEP 1122.

**F6**

Installation of the fuel-injection pump  
Volvo 240 D, 760 D-Turbo





Note:

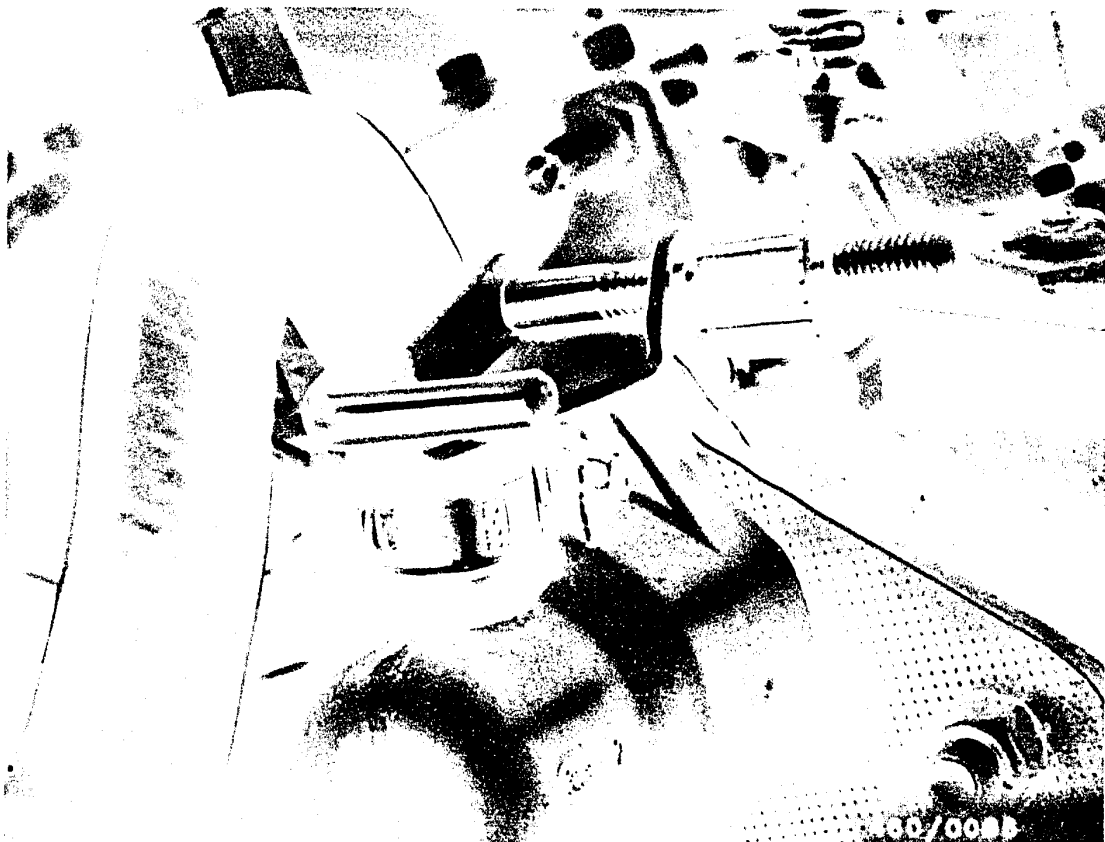
In the next step, make certain that the torque wrench is put on the box wrench KDEP 1120 in such a way that the two wrenches are at exactly rightangles ( $90^\circ$ ) to one another.

If that is not the case, the tightening torque is not shown correctly.

Hold the camshaft gear in place using holding wrench KDEP 1116, and using box wrench KDEP 1120, tighten to 100 Nm.

Remove locating mandrel KDEP 1122.





Connect the coolant lines to the control device for the fuel-injection pump and remove the crimping clamp.

Screw the hose clamps on tight.

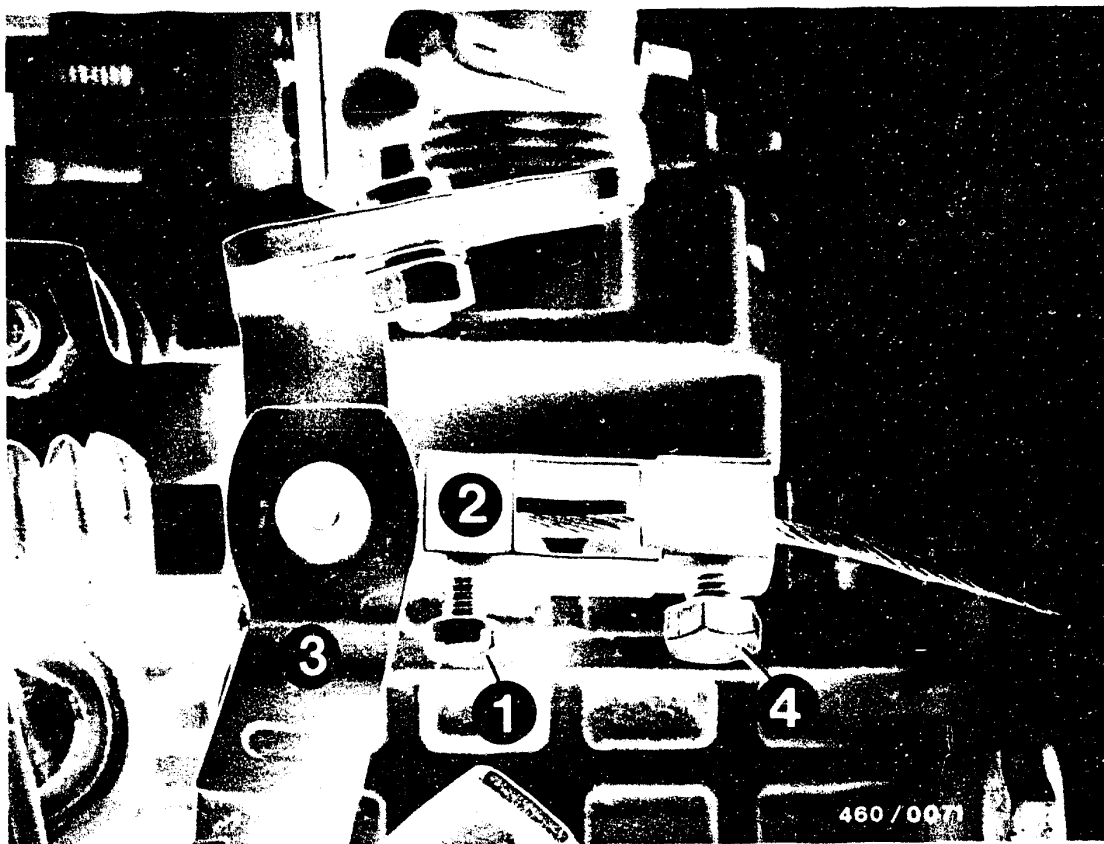
Put in the toothed-belt cover.

**F8**

Installation of the fuel-injection pump

Volvo 240 D, 760 D-Turbo





For testing and adjustment of the start of fuel delivery, the temperature-controlled cold-start accelerator (KSB) must be in the zero position.

Release the clamping screw (1) on the fuel-injection pump.

Pull the spacer piece (2) with the control lever (3) toward the hydraulic head.

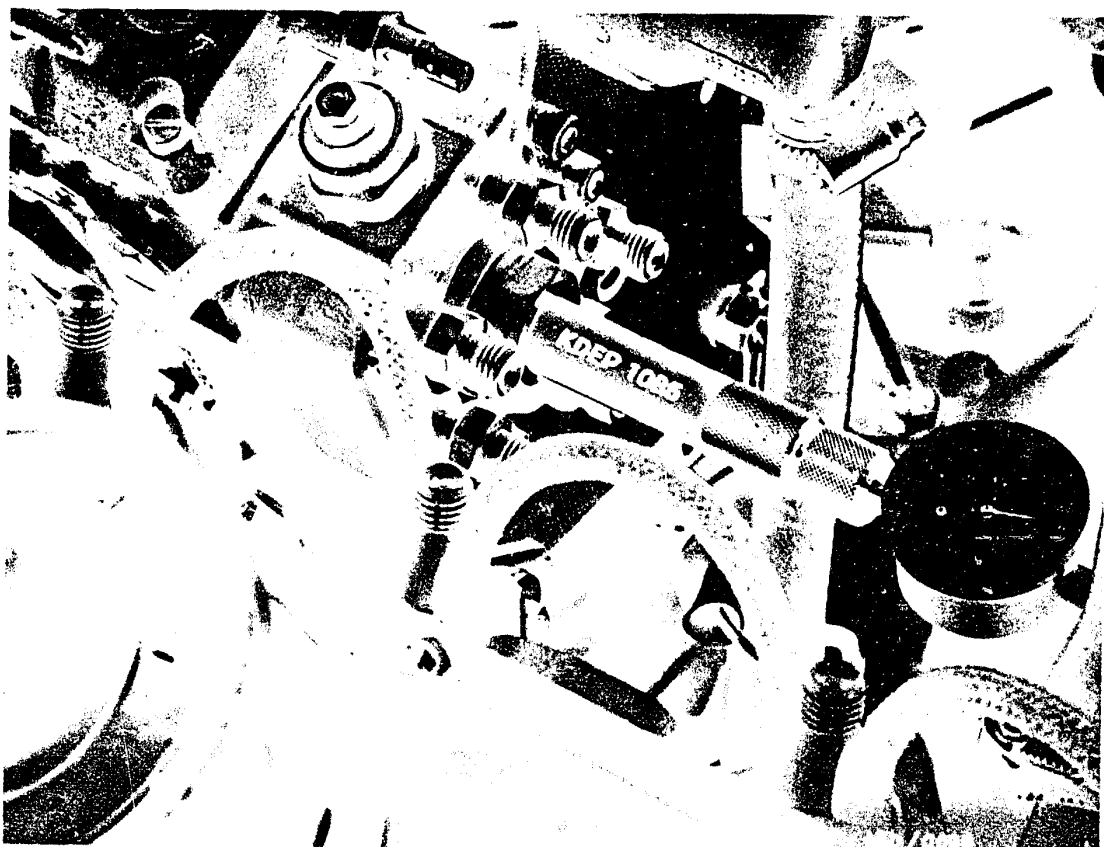
Turn the spacer piece (2) by 90° and shove it further in the direction of the drive shaft, until the control lever (3) touches up against the stop bracket. In this position, the control device has been shut off.

N.B.!

It is not permissible to release locking screw (4). Otherwise a readjustment of the control device becomes necessary.







Unscrew the bleeder screw from the center screw plug (triangular screw) of the hydraulic head.

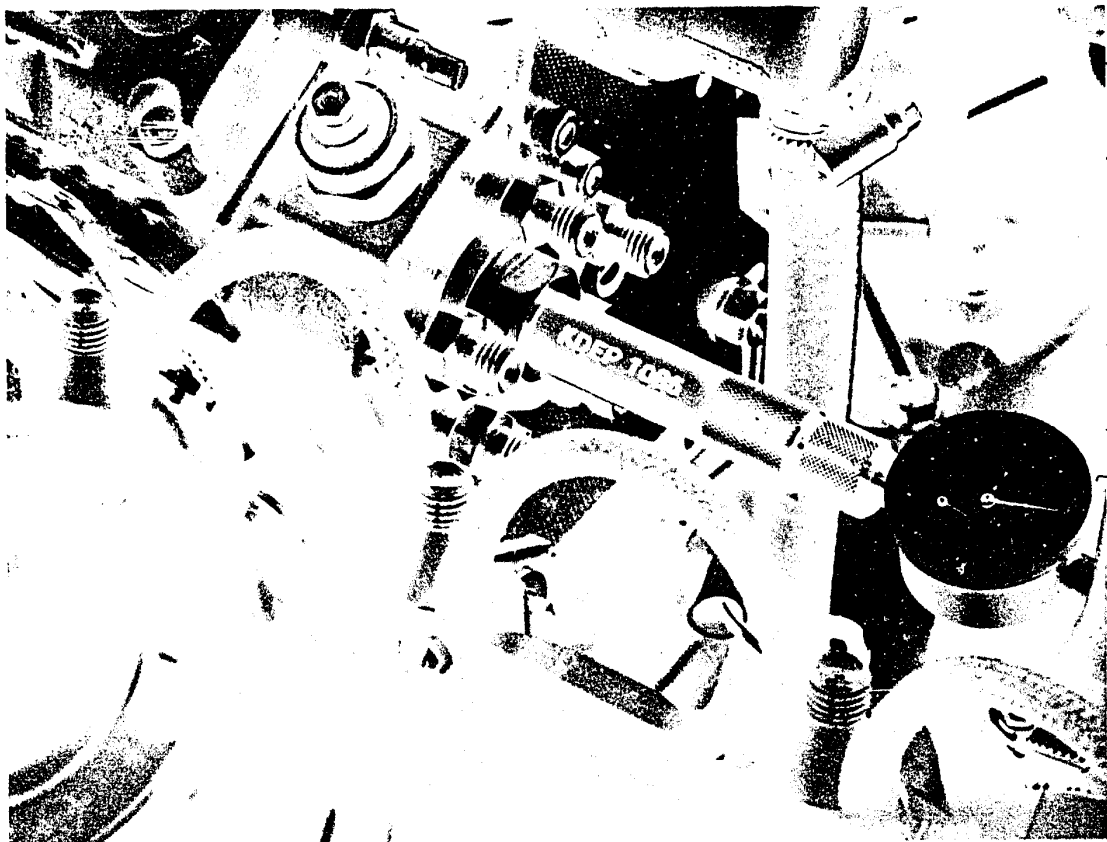
Mount tester KDEP 1085 and the dial indicator in the threaded hole.

Prestress the dial indicator approx. 2.5 mm.

Slowly turn the crankshaft counter to the direction of engine rotation until the needle on the dial indicator no longer moves.

Set the dial indicator at "0".





Turn the crankshaft in the direction of engine rotation until the TDC marking on the flywheel aligns with the reference mark on the coupling housing.

Check the position of the pump gear using locator mandrel KDEP 1122.

As a setting dimension, the dial indicator must show one of the following values:

Pump setting 0.70 mm ABDC (engine D 24)

Pump setting 0.80 mm ABDC (engine D 24 Turbo)





If a correction is required, release the fastening screws on the fuel-injection pump, and adjust the stroke in question by swiveling.

Setting values:

Pump setting 0.70 mm ABDC (engine D 24)

Pump setting 0.80 mm ABDC (engine D 24 Turbo)

Tighten fastening screws to 25 Nm.

Turn the crankshaft twice and recheck the setting.

Remove measuring device KDEP 1085 and dial indicator.  
Put on the bleeder screw using a new seal ring.



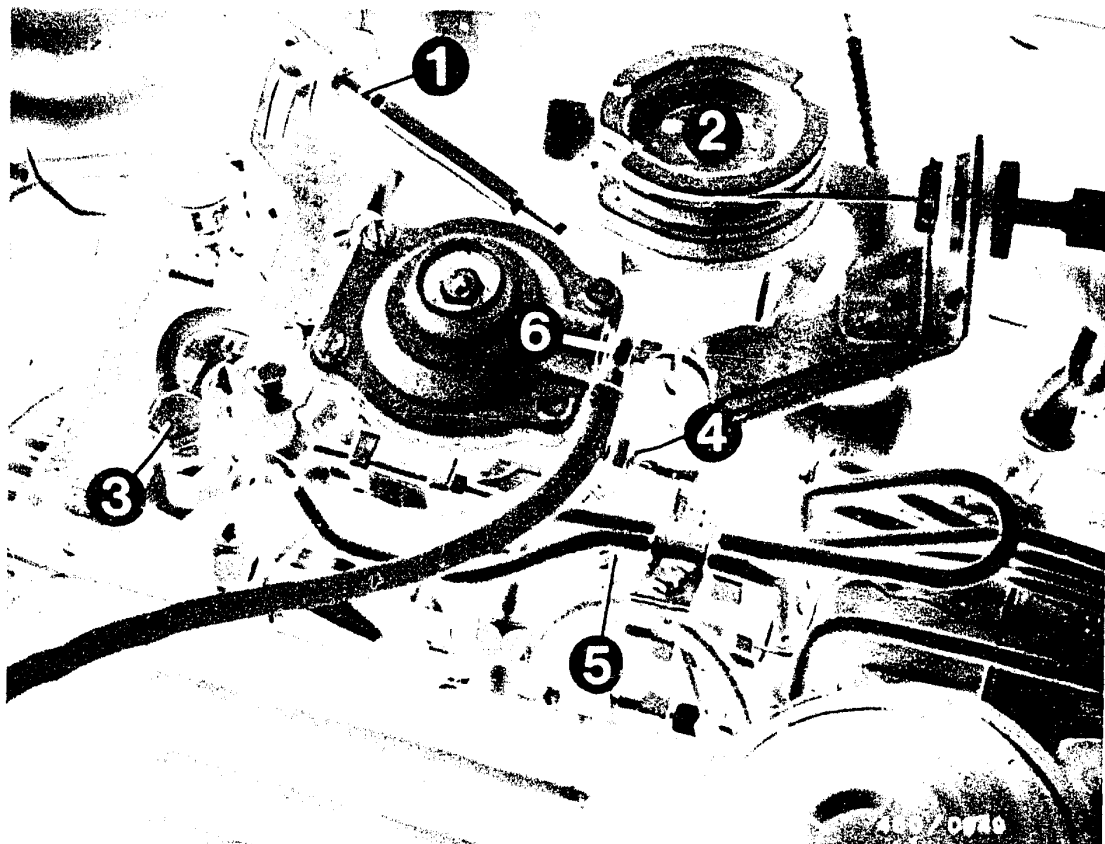


Tighten the fuel-injection lines using an open box wrench KDEP 1115 (prevent turning of the pressure valve holders by holding them with the wrench).

**F13**

Installation of the fuel-injection pump  
Volvo 240 D, 760 D-Turbo





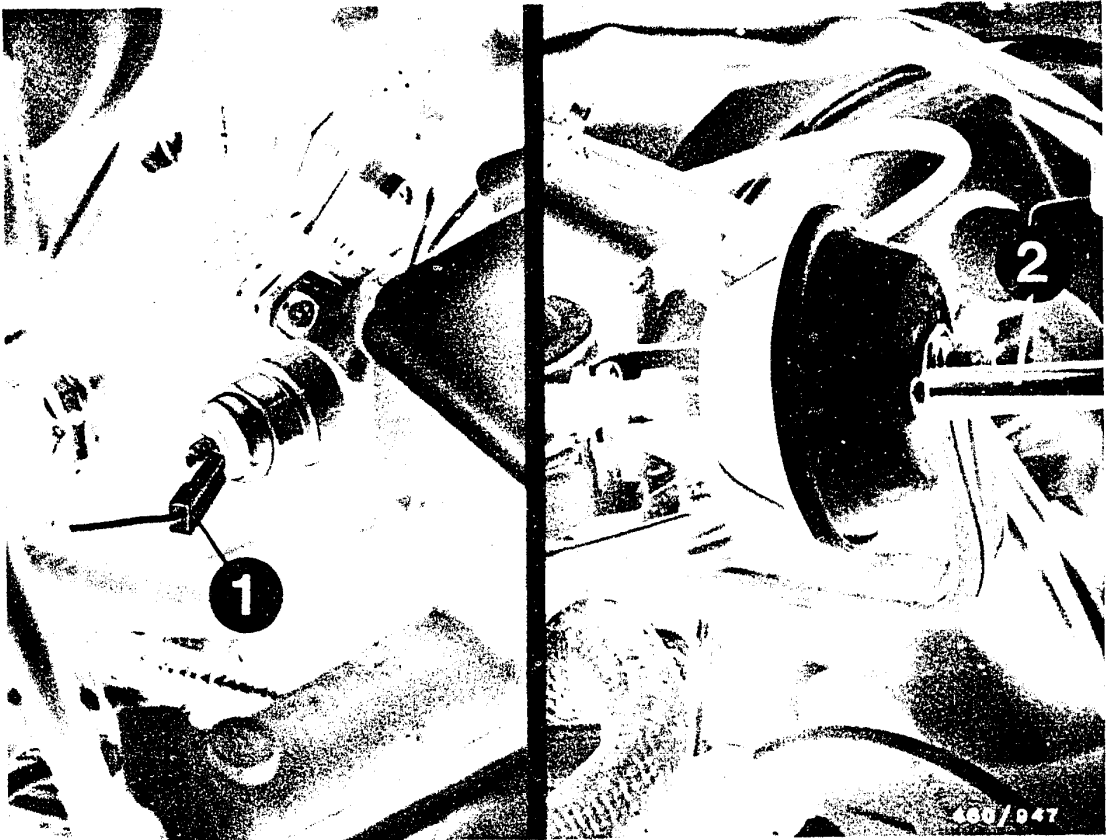
Put on the connector between the guide roller and the control lever (1), the guide roller with the holder for the cable (2), the fuel inlet line (3), the return line (4), the lead for the electric shutoff device (5) and the charge-air connection (6).

Note:

Do not mistake the inlet-union screws for the fuel inlet and return lines one for the other.

The inlet-union screw for the return has throttle holes and is identified on the screw head with the word "OUT".





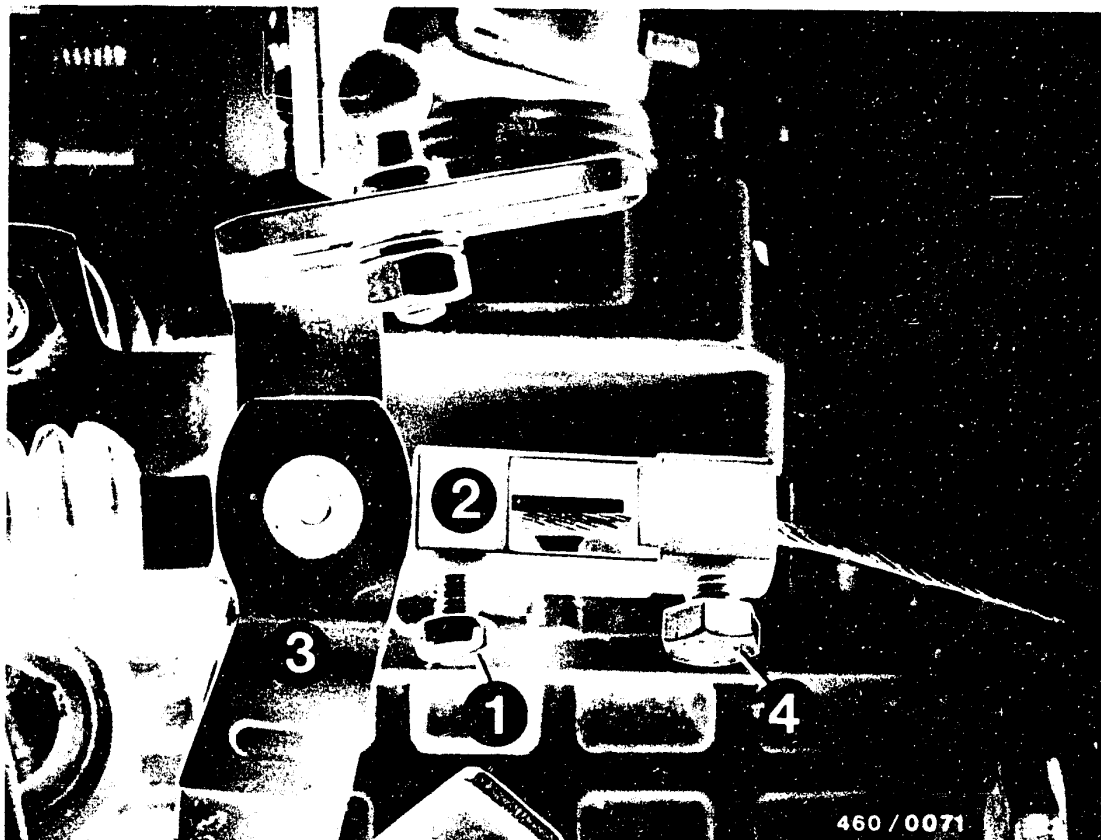
Put on the lead to the solenoid valve (1) and the vacuum hose (2). (Only for vehicles with cruise control).

Connect the negative lead to the battery.

**F15**

Installation of the fuel-injection pump  
Volvo 240 D, 760 D-Turbo





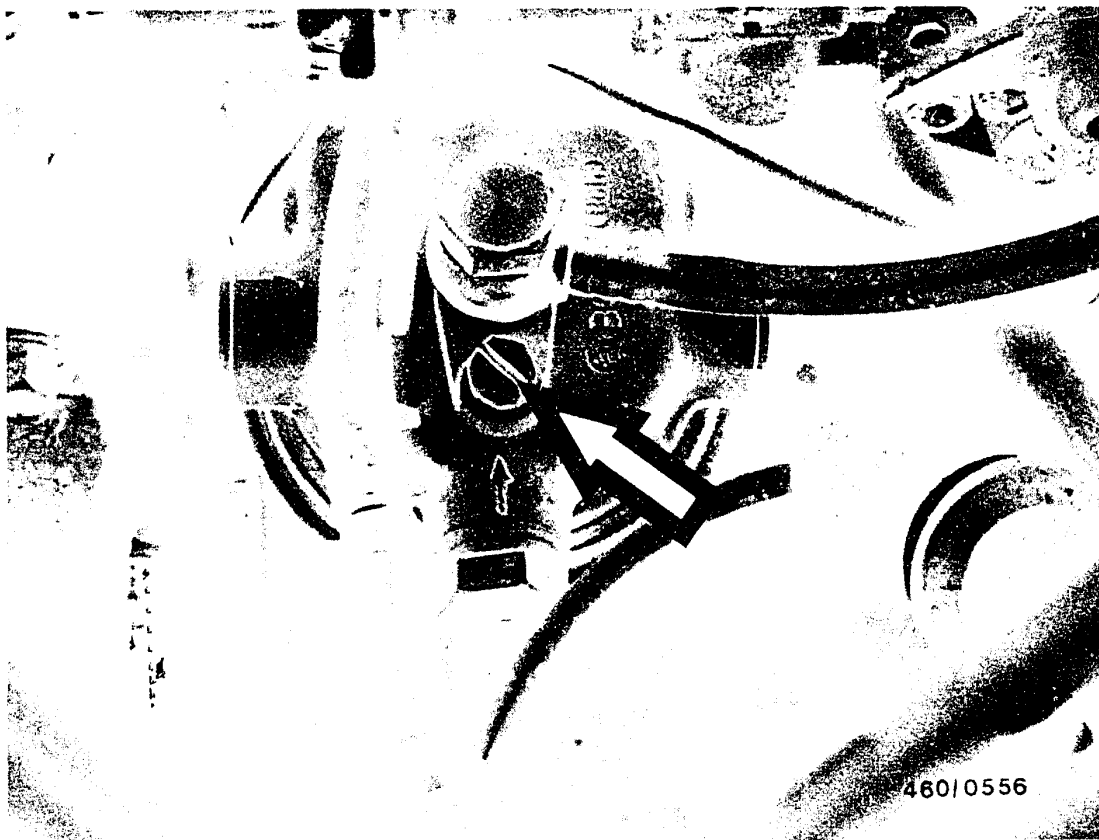
Pull the control lever (3) with the spacer piece (2) toward the hydraulic head.

Turn the spacer piece (2) by 90° and shove further in the direction of the drive shaft.

The spacer piece is now in its initial position.

Tighten the clamping screw (1).





### Bleed the fuel system

Fill the fuel filter and the fuel-injection pump with diesel fuel.

Tighten the hose connections to the filter cover.

Plug the bleeder screw (if it is there) on the fuel filter (arrow).







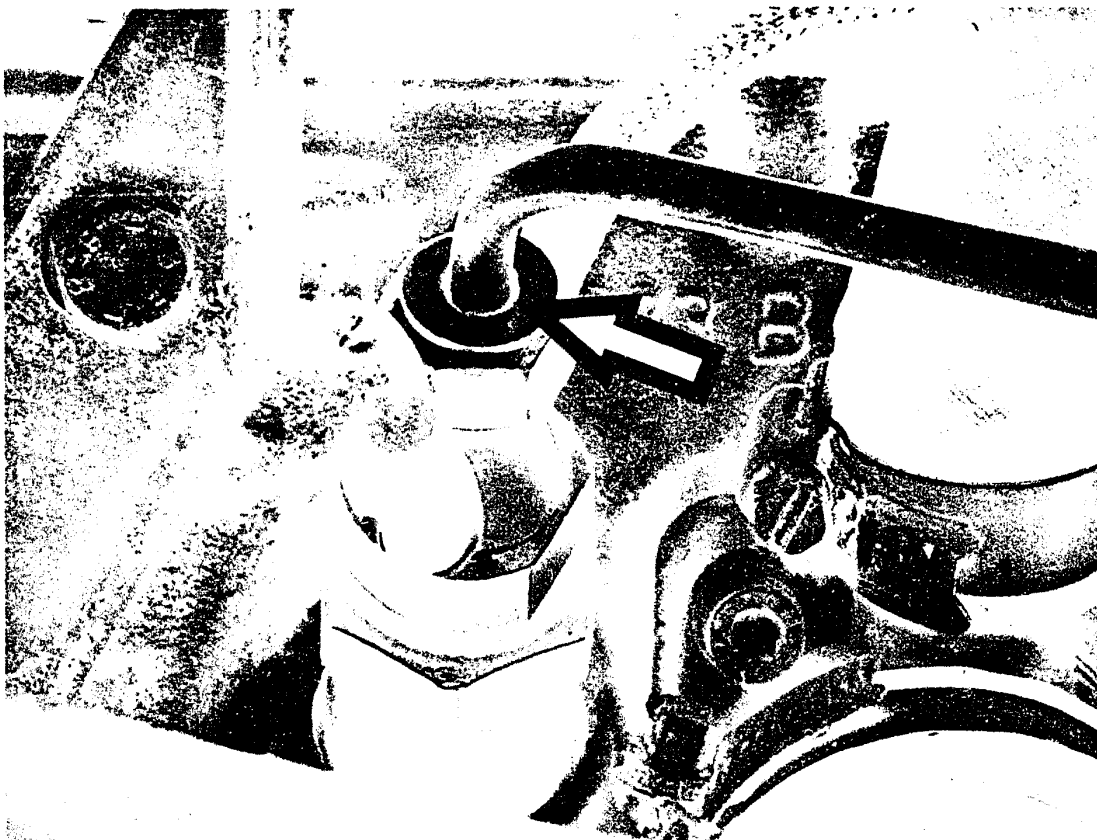
Release the bleeder screw on the fuel-injection pump and unscrew it by a few turns (arrow).

Release the inlet-unions on the supply lines to the fuel-injection nozzle holders.

Turn on the engine starting motor, without preheating.

When the fuel coming out of the bleed hole on the fuel-injection pump no longer has any bubbles in it, tighten the bleeder screw.



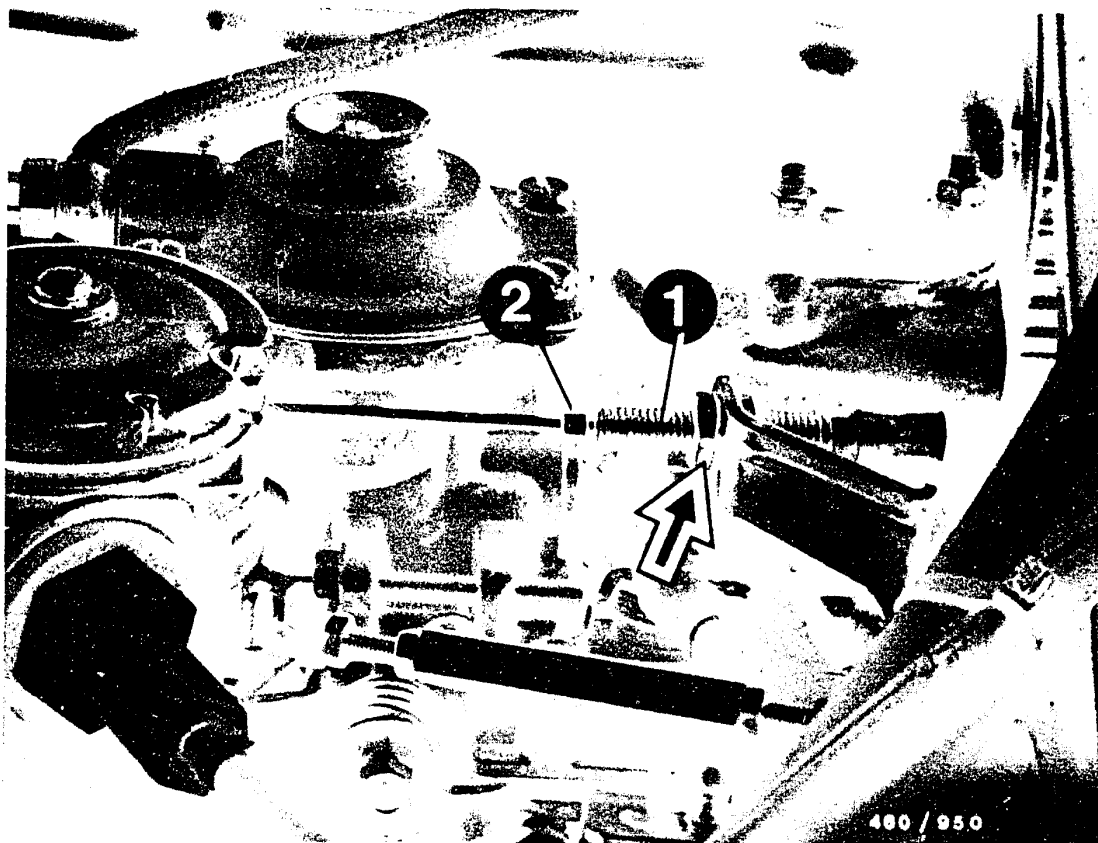


Continue operating the starting motor until fuel comes out at the inlet-union nuts of the fuel-injection nozzle holders (arrow).

Tighten the inlet-union nuts.

Run the starting motor until the engine turns over.





### Adjustment of Kick Down

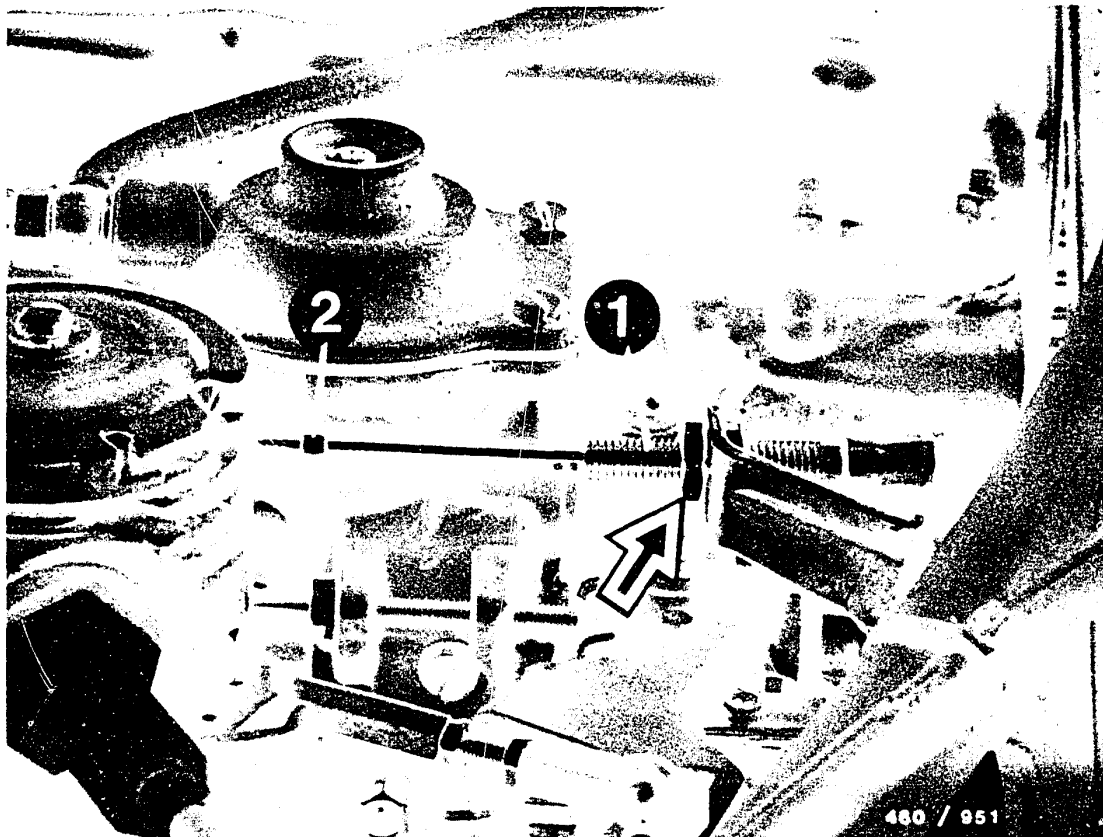
Requirement:

- Engine at normal operating temperature, cooling water temperature + 80°C.

Adjustment at idle:

- Release the lock nut (arrow) and set the guide sleeve (1) at a distance of 0.25 ... 1.0 mm from the cable clamp (2).
- Tighten the lock nut, recheck the setting.





### Adjustment of Kick Down

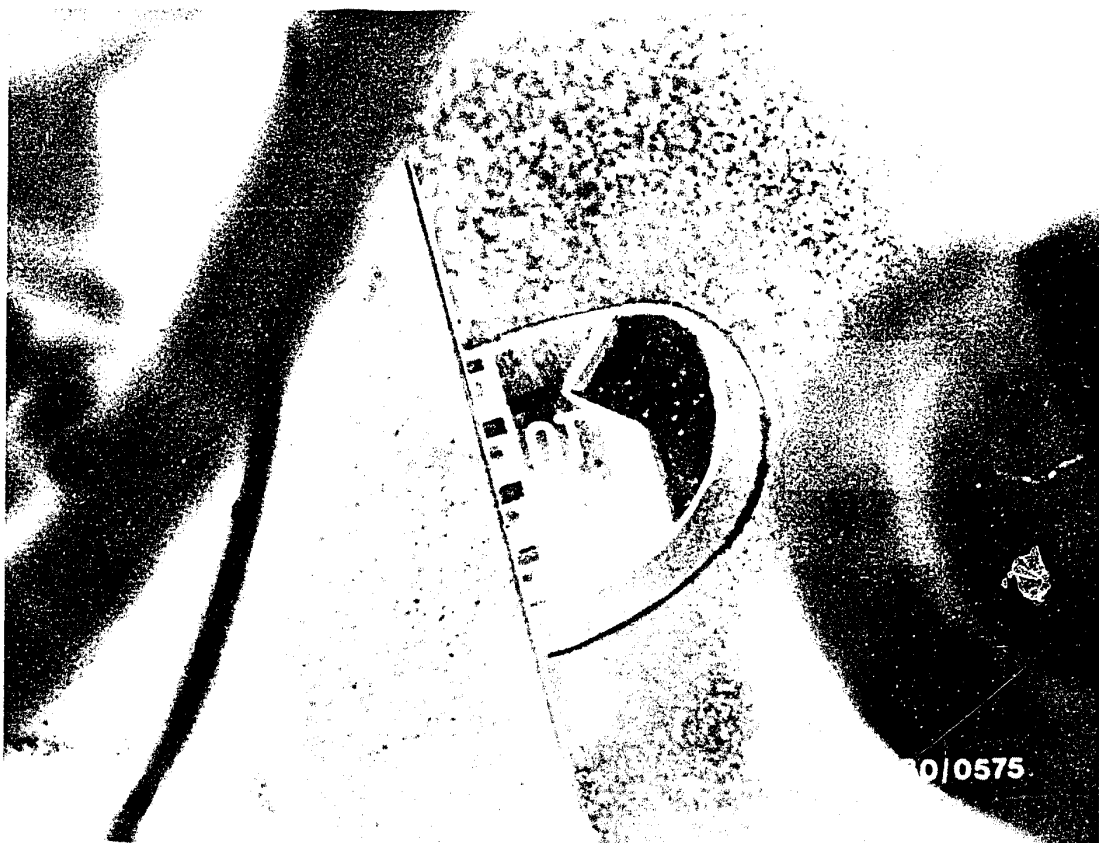
- Press down on the accelerator pedal to the kick down point.
- Release the lock nut (arrow) and set the guide sleeve (1) to a distance of

$$51 \begin{array}{l} + 1.6 \\ - 0.6 \end{array} \text{ mm}$$

from the cable clamp (2).

- Tighten the lock nut, recheck the setting.





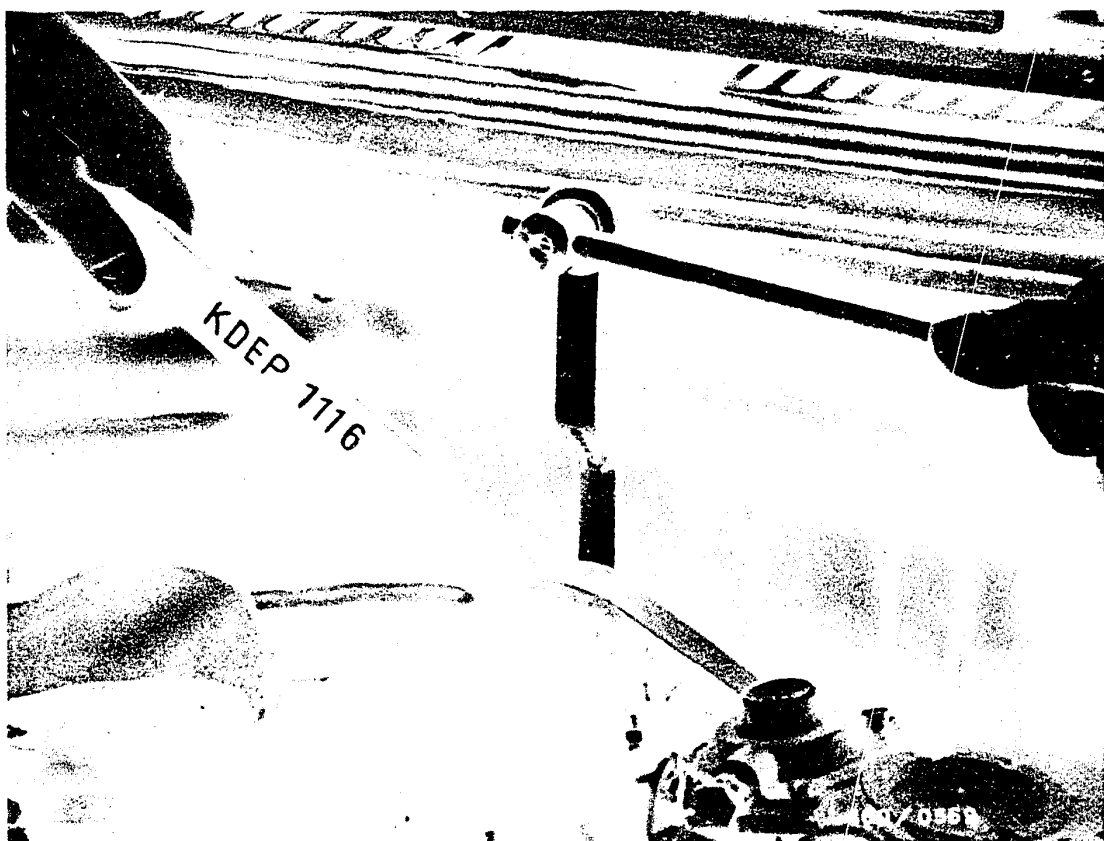
## 29. Checking and adjusting engine timing

### 29.1 Checking engine timing

Remove the cylinder head cover and the protective cover of the toothed belt for the fuel-injection pump. Turn the crankshaft to the first cylinder TDC (the 6th cylinder is at valve overlap).

The marking on the flywheel and the reference marking on the coupling housing must align.





Fix the fuel-injection pump gear in place using locator mandrel KDEP 1122.

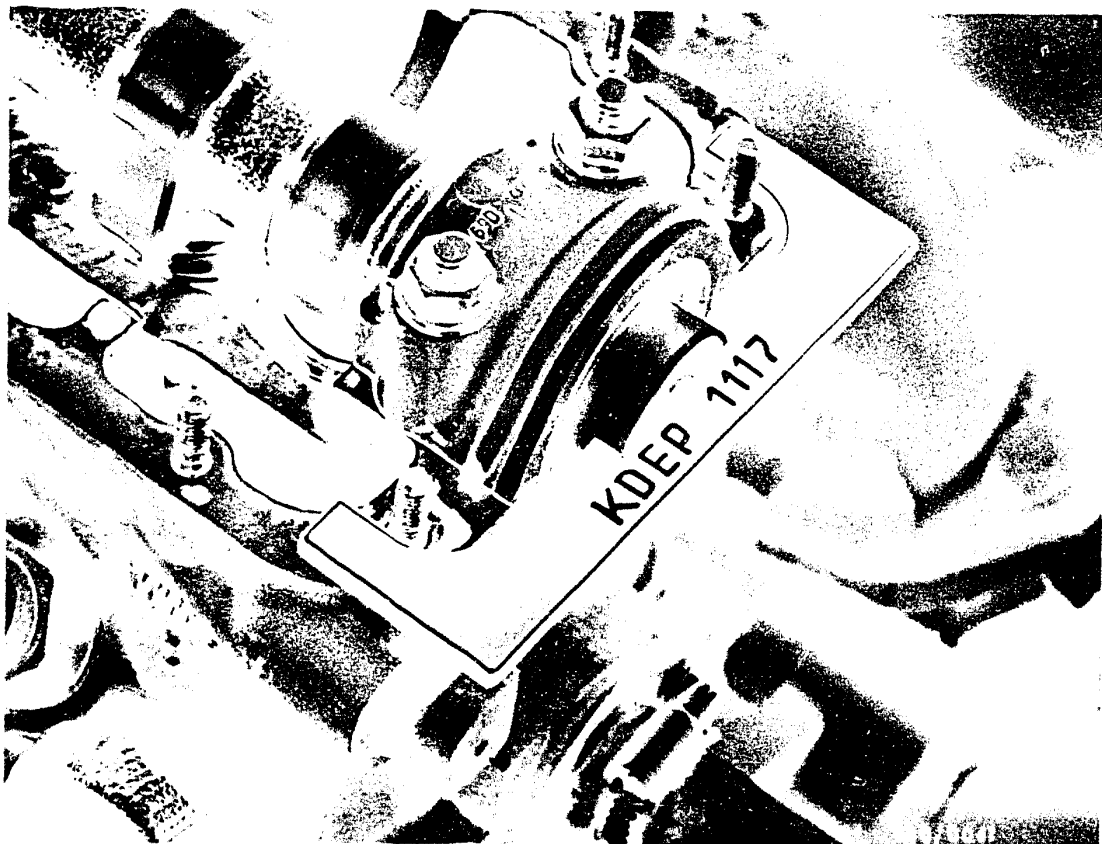
Hold the camshaft gear in place using wrench KDEP 1116.

Release the fastening screw on the camshaft gear using box wrench KDEP 1120, and unscrew it.

Take off the camshaft gear and the toothed belt from the camshaft of the engine.

Recheck the TDC position on the flywheel.

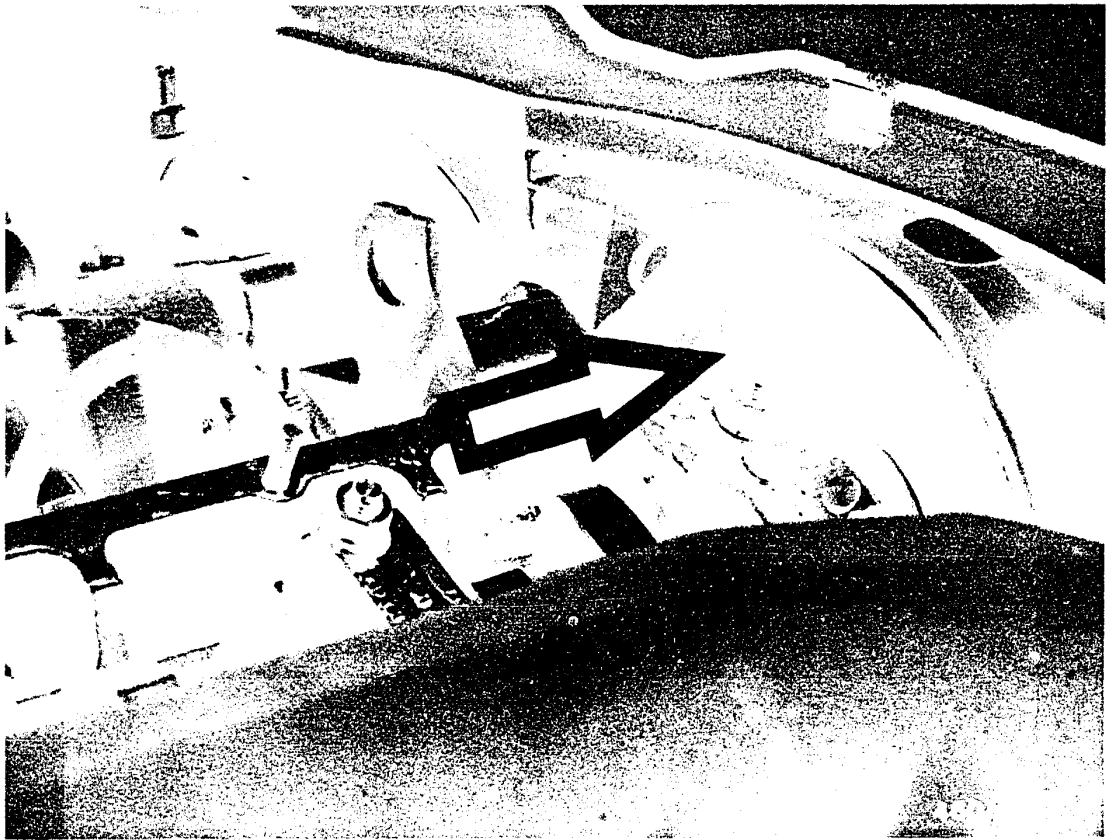




Insert adjusting straight edge KDEP 1117 into the recess on the camshaft.

If the adjusting straight edge cannot be inserted, correct the engine timing control.





### 29.2 Adjusting engine timing

Turn the crankshaft far enough so that the adjustment straight edge can be inserted.

Remove the toothed-belt protective cover for the camshaft drive.

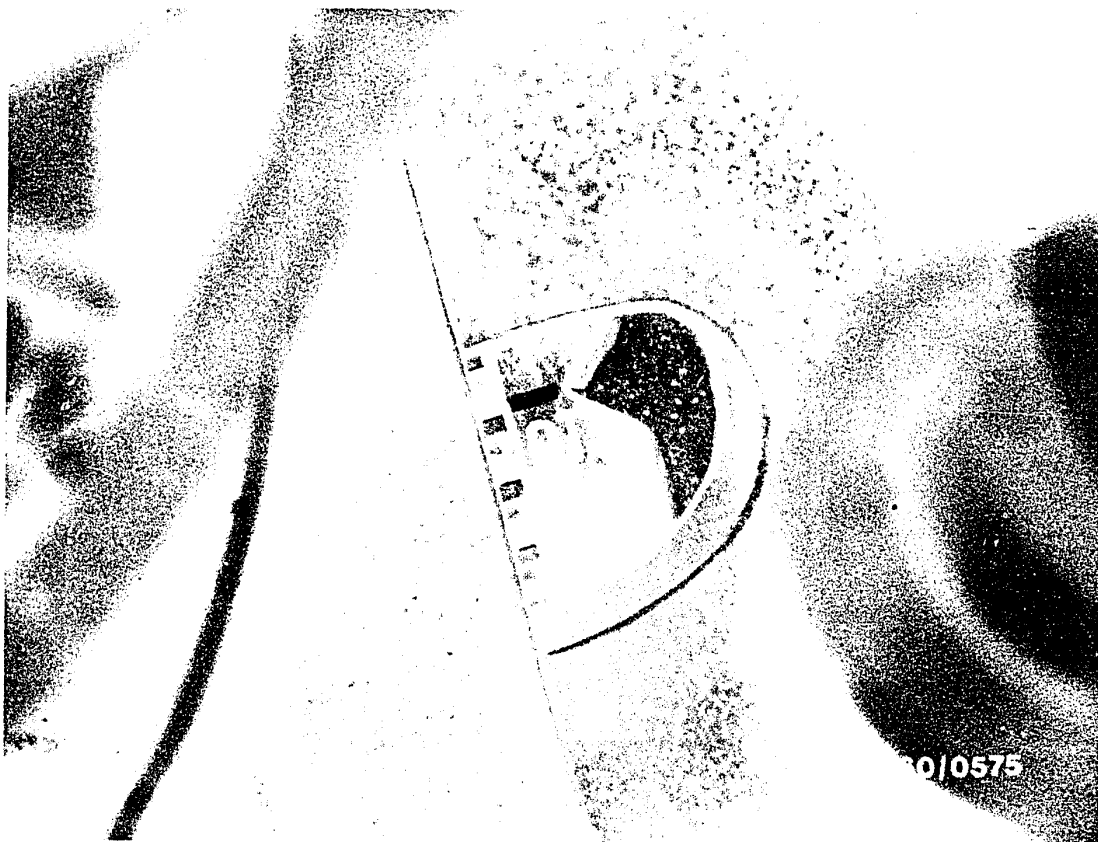
Release the fastening screw on the camshaft drive gear by one turn.

Remove the camshaft drive gear from the camshaft by striking it with a hammer.

To do this, introduce the mandrel through the opening in the cover plate (arrow).

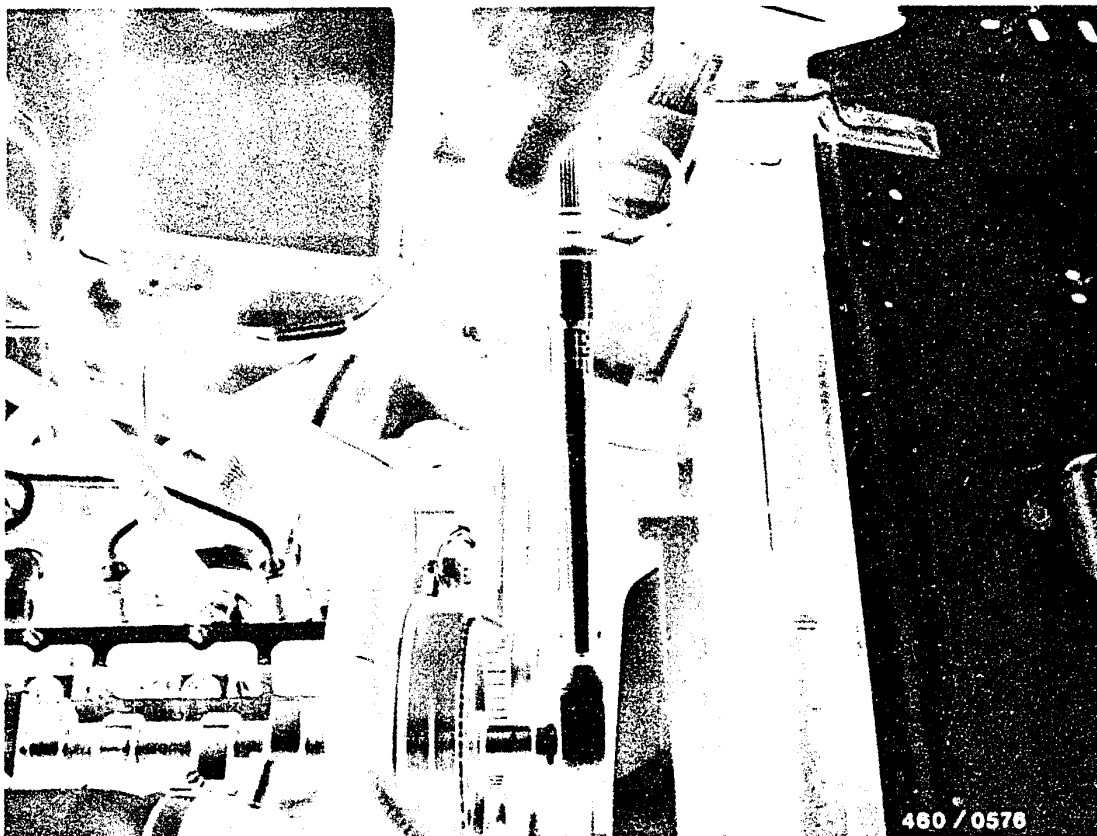






Turn the crankshaft, until the TDC marking on the fly-wheel aligns with the reference marking on the coupling housing.





Tighten the camshaft drive gear in this position to 45 Nm.

Remove adjusting straight edge KDEP 1117.

Put on the toothed-belt protective cover and the cylinder head cover.



Put on the toothed belt for the fuel-injection pump and the camshaft gear.

Hand-tighten the fastening screw just far enough so that the camshaft gear can still be moved.

Remove locating mandrel KDEP 1122.



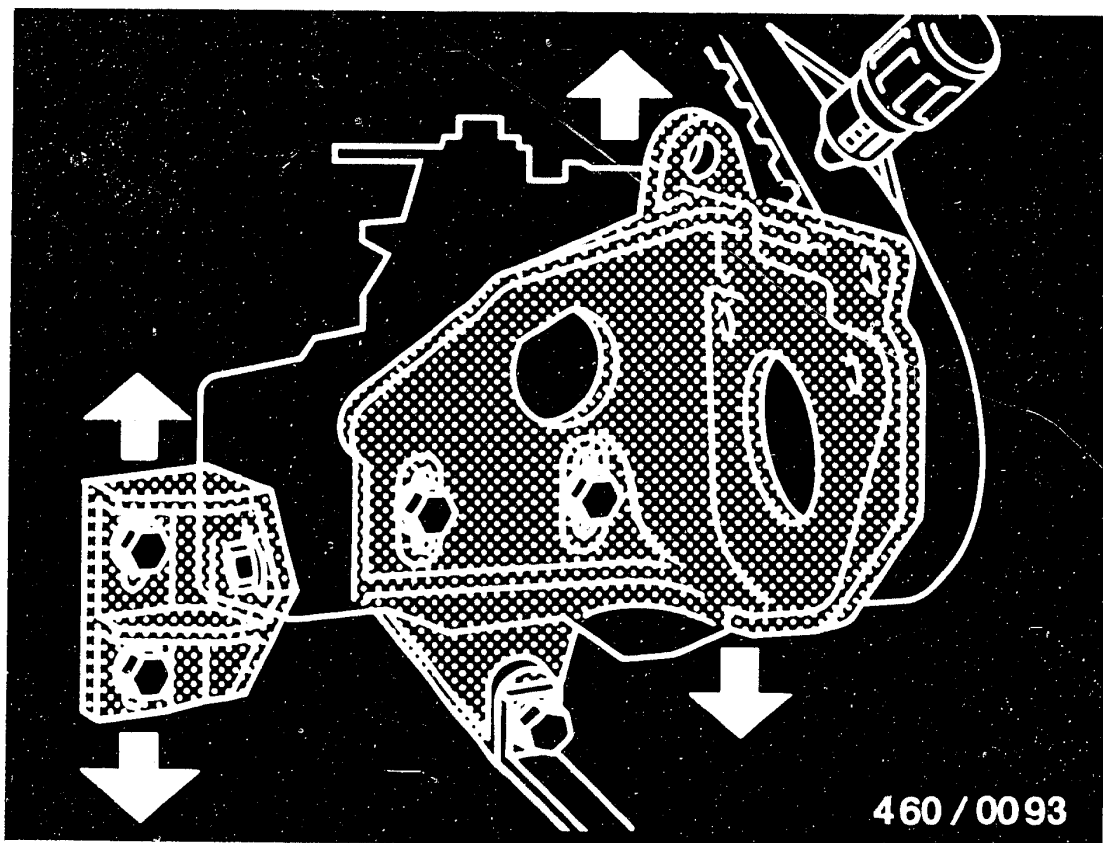
Check toothed-belt tensioning using the belt tensioning tester KDEP 1121:

Put on the belt tensioning tester as shown in the picture.

Turn the vernier casing until the lower edge of the casing coincides with the line marking on the measuring leaf.

Take the measurement:

Specified measurement = Scale value 12 ... 13

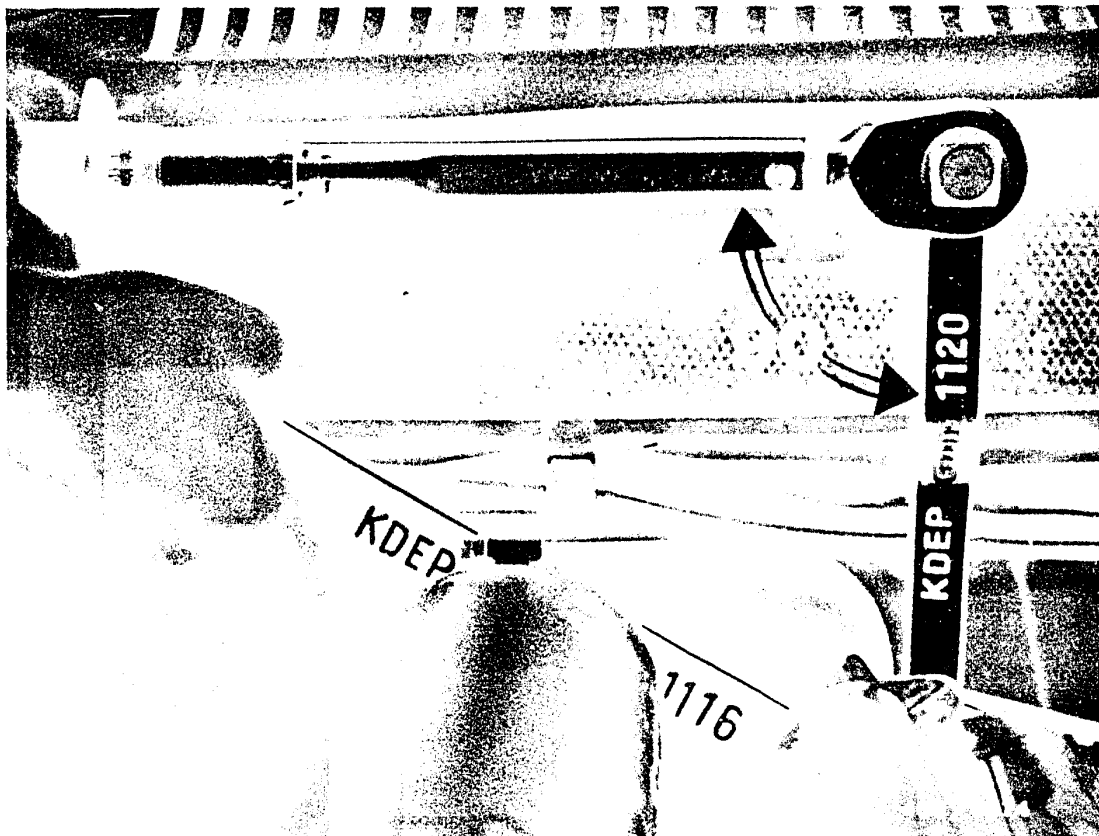


If the actual dimension deviates from the specified value, release the fastening screws of the pump console and of the holding bracket on the hydraulic head.

Shove the fuel-injection pump and the console up or down accordingly (arrows).

Tighten the fastening screws for the pump console and the holding bracket to 65 Nm.

Turn the engine crankshaft twice and recheck the toothed belt tensioning.



Note:

In the following step, make certain that the torque wrench is put on the box wrench KDEP 1120 so that the two wrenches are exactly at right angles ( $90^\circ$ ) to one another.

If that is not the case, the tightening torque is not recorded correctly.

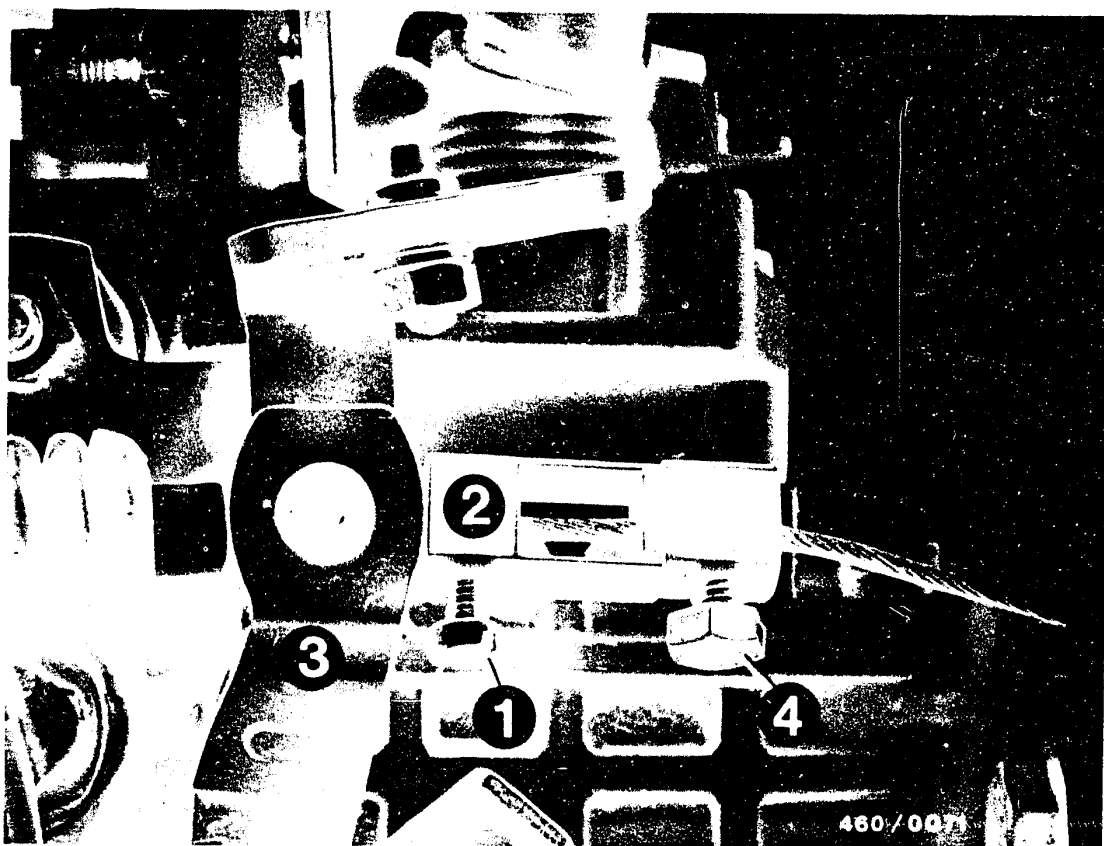
Recheck the TDC position of the crankshaft.

Hold the fuel-injection pump gear in place using locator mandrel KDEP 1122.

Hold the camshaft gear in place using wrench KDEP 1116, and, using box wrench KDEP 1120, tighten it to 100 Nm.

Remove locator mandrel KDEP 1122.





When testing and adjusting the start of fuel delivery, the temperature-controlled cold-start accelerator (KSB) must be in the zero position.

For this, release the clamping screw (1) on the fuel-injection pump.

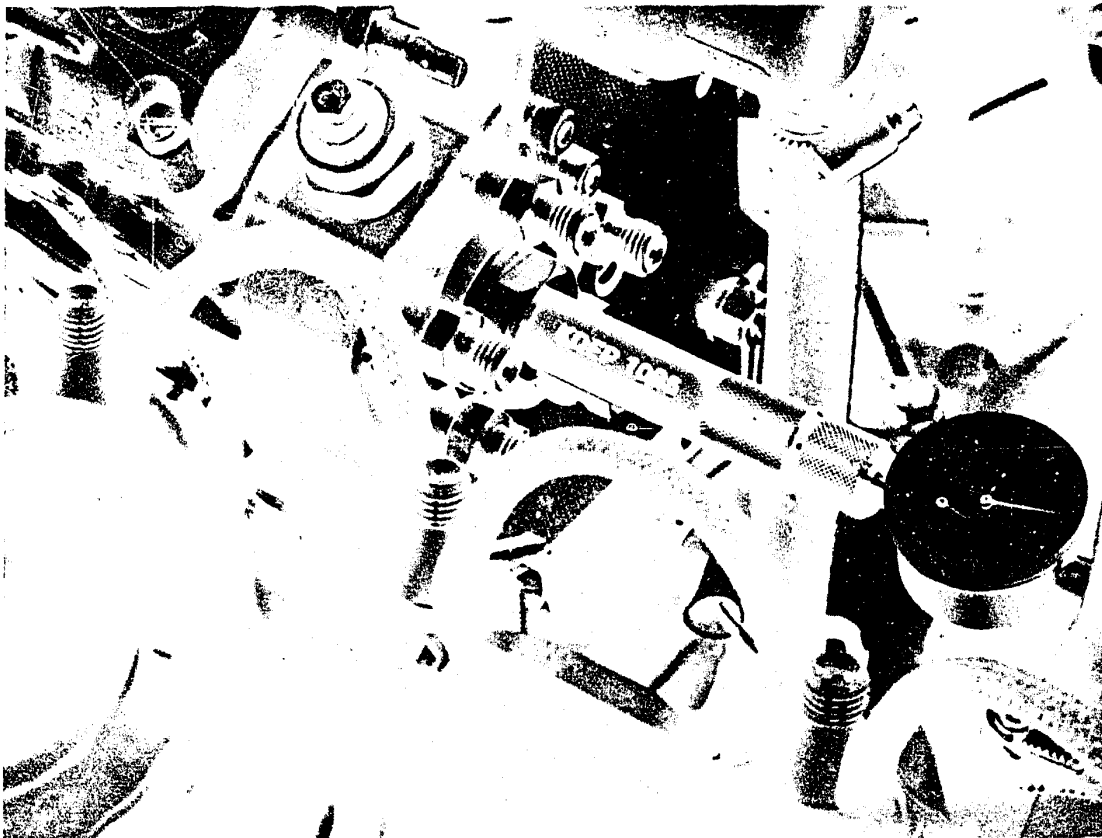
Pull the spacer piece (2) and the control lever (3) toward the hydraulic head.

Turn the spacer piece (2) by 90° and shove it again in the direction of the drive shaft, until the control lever (3) touches against the stop bracket.

In this position, the control device has been turned off.

N.B.!

It is not permissible to release locking screw (4). Otherwise readjustment of the control device is required.



Remove the fuel-injection lines on the fuel-injection pump and the nozzle holder assemblies (prevent loosening of the pressure valve holders by holding them with the wrench).

Unscrew the bleeder screw from the center screw plug (triangular screw) of the hydraulic head.

Mount measuring device KDEP 1085 and dial indicator in the threaded hole.





Prestress the dial indicator approx. 2.5 mm.

Turn the crankshaft slowly counter to the direction of engine rotation until the needle on the dial indicator no longer moves.

Set the dial indicator at "0".

Turn the crankshaft in the direction of engine rotation until the TDC marking on the flywheel aligns with the reference marking on the coupling housing.

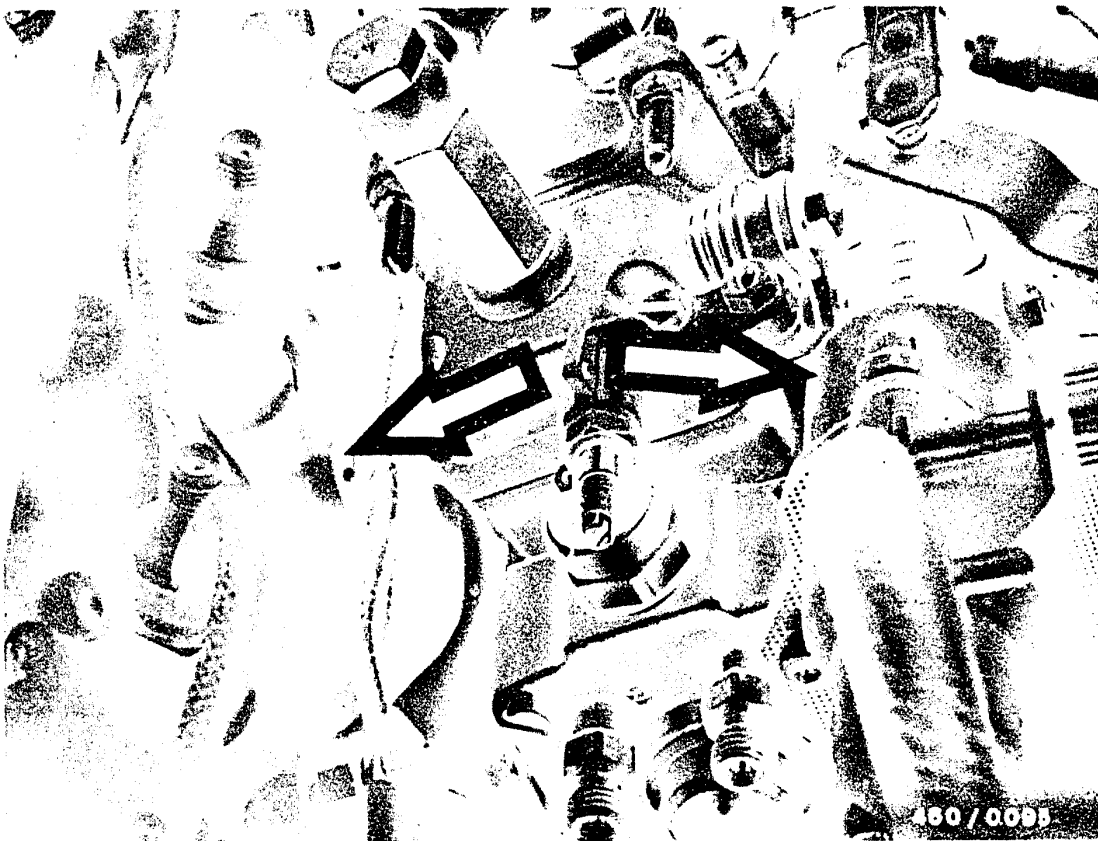
Check the position of the pump gear using locator mandrel KDEP 1122.

As a rechecking dimension, the dial indicator must indicate one of the following values.

Pump setting 0.65 ... 0.73 mm ABDC (engine D 24)

Pump setting 0.78 ... 0.85 mm ABDC (engine D 24 Turbo)





If a correction is required, release the fastening screws for the fuel-injection pump and set the stroke in question by means of pivoting.

Setting values:

Pump setting 0.70 mm ABDC (engine D 24)

Pump setting 0.80 mm ABDC (engine D 24 Turbo)

Tighten fastening screws to 25 Nm.

Turn crankshaft twice and recheck the setting.



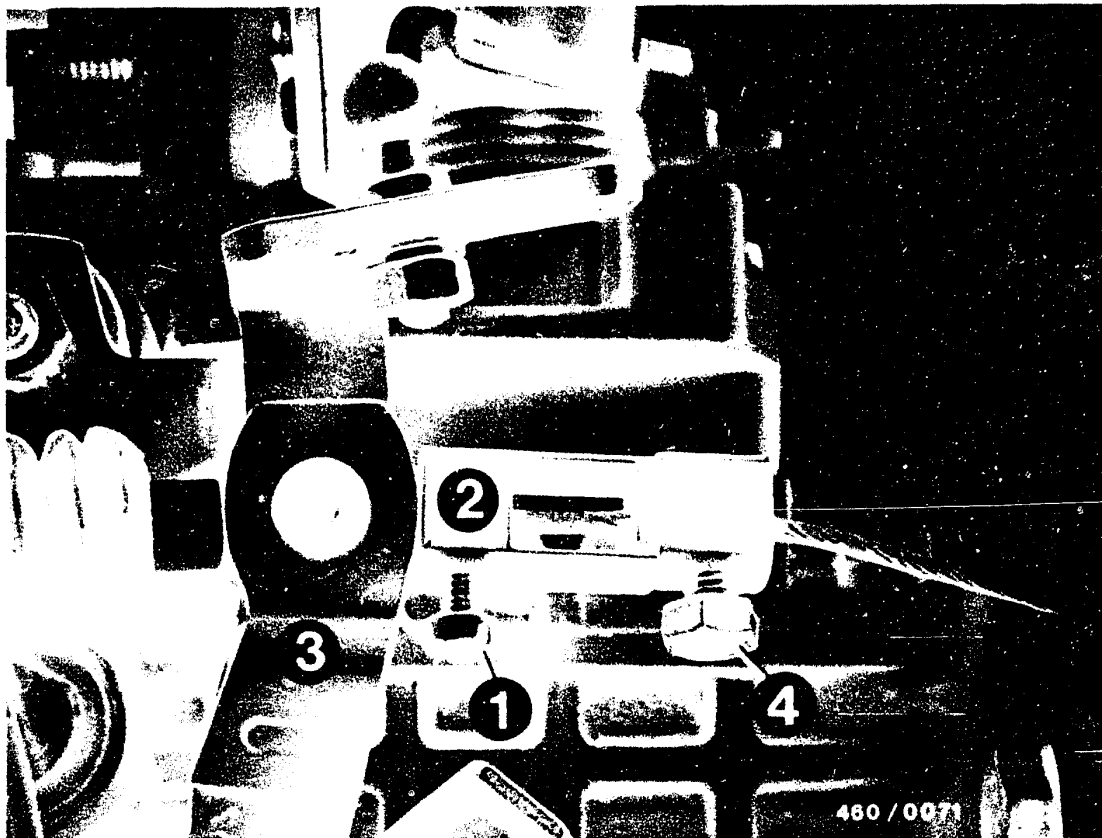
Remove measuring device KDEP 1085 and dial indicator.

Screw in the bleeder screw using a new seal ring.

Put on the toothed-belt cover.

Screw the fuel-injection lines on the pressure valve holders for the fuel-injection pump and the nozzle holder assemblies (prevent turning of the pressure valve holders by holding them with a wrench).





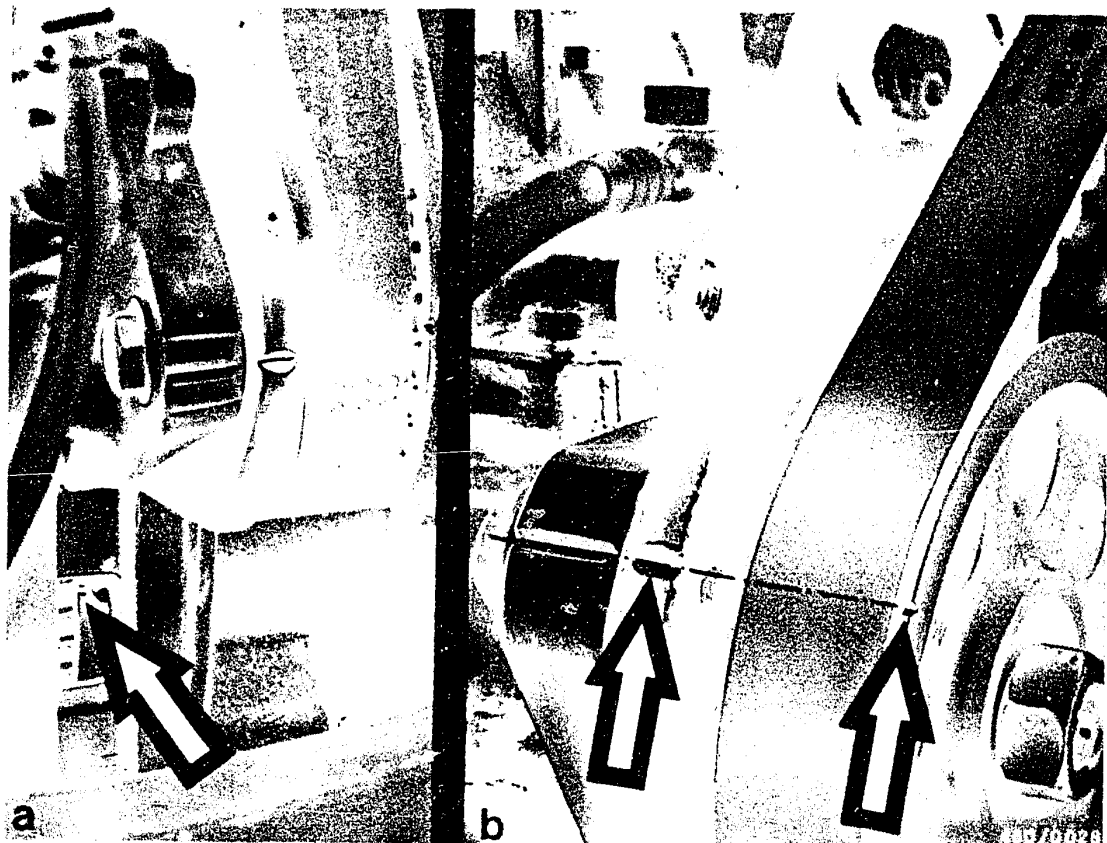
Pull the control lever (3) and the spacer piece (2) toward the hydraulic head.

Turn the spacer piece (2) by 90° and shove it again in the direction of the drive shaft.

The spacer piece is now in its initial position.

Tighten the clamping screw (1).





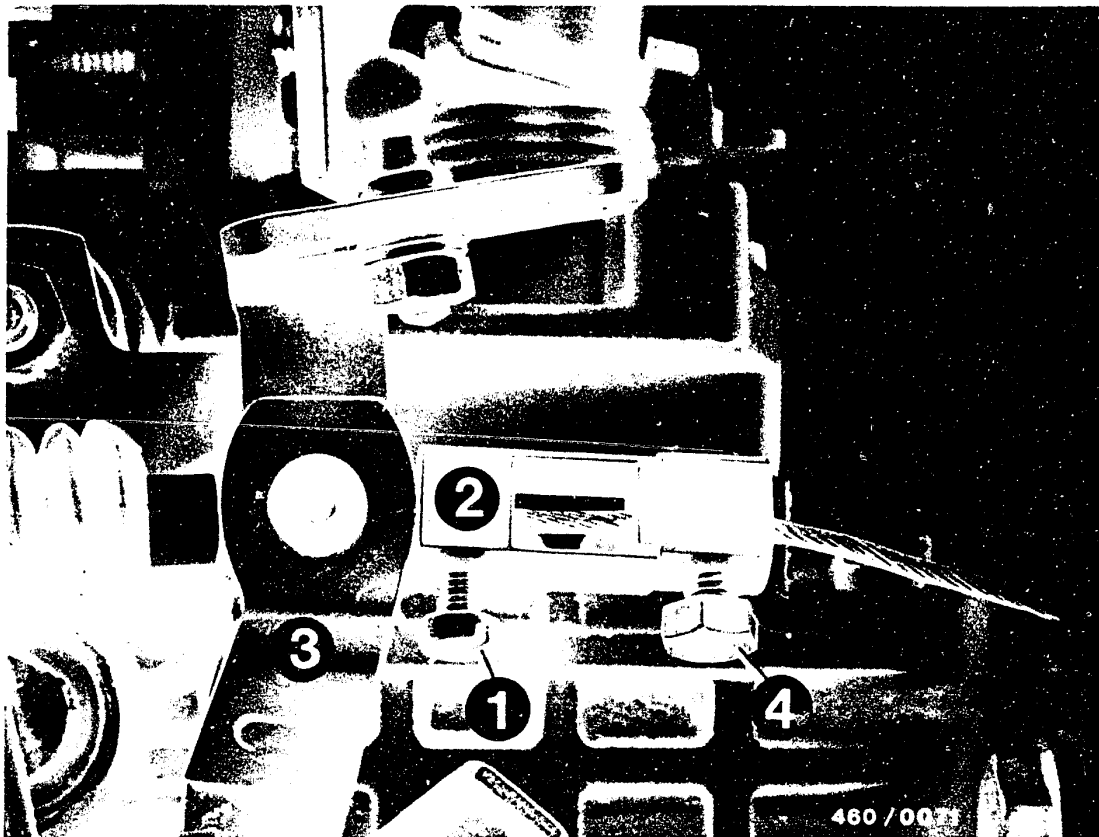
### 30. Injection timing

Remove the toothed-belt protective cover and the fuel-injection lines.

Turn the crankshaft until the marking on the flywheel aligns with the reference marking on the coupling hood (Fig. a - arrow).

In this position, the notch marking on the fuel-injection pump gear and the pump console must agree (Fig. b - arrows).





For testing and adjusting the start of fuel delivery, the temperature-controlled cold starting accelerator (KSB) must be in the zero position.

For this, release the clamping screw (1) on the fuel-injection pump.

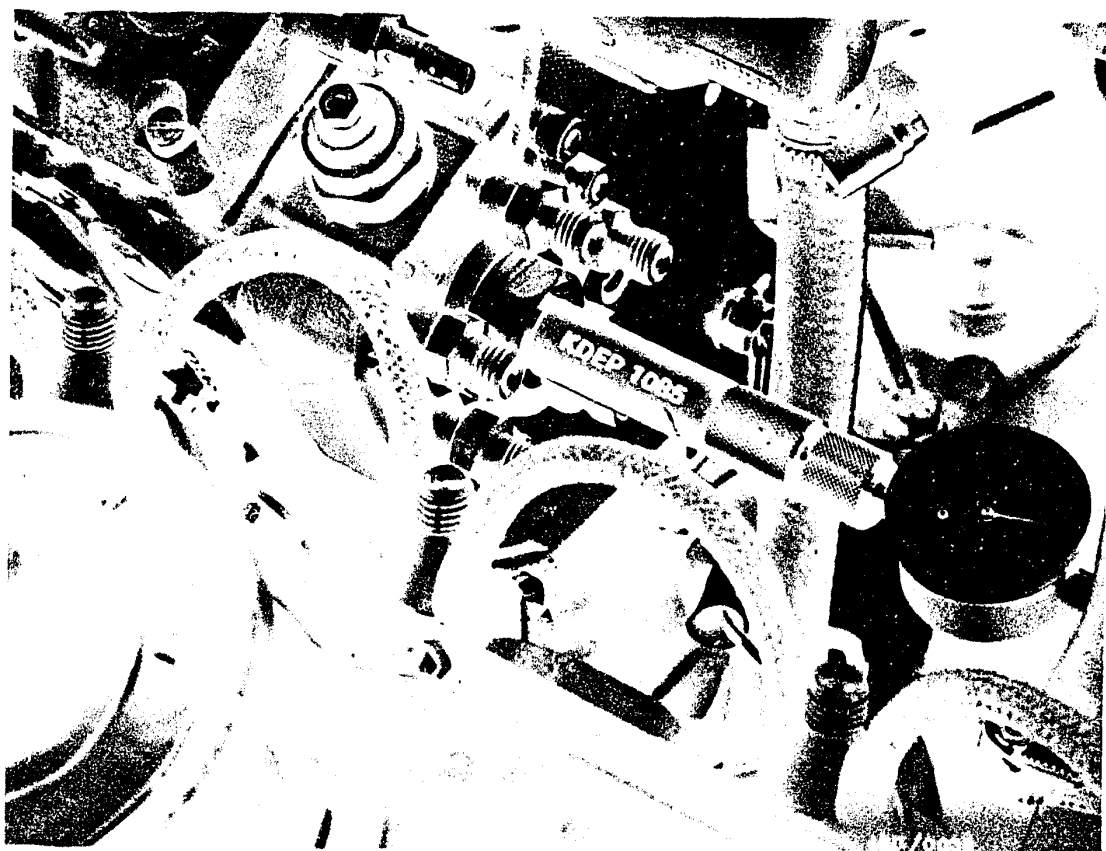
Pull the spacer piece (2) and the control lever (3) toward the hydraulic head.

Turn the spacer piece (2) by 90° and shove it again toward the driving shaft, until the control lever (3) touches against the stop bracket. In this position, the control device has been turned off.

N.B.!

It is not permissible to release locking screw (4). Otherwise a readjustment of the control device is required.





Remove the fuel-injection lines on the fuel-injection pump and the nozzle holder assemblies (prevent the pressure valve holders from becoming loose by holding them with a wrench).

Screw out the bleeder screw from the central screw plug (triangular plug) of the hydraulic head.

Mount measuring device KDEP 1085 and dial indicator in the threaded hole.



Prestress the dial indicator approx. 2.5 mm.

Slowly turn the crankshaft counter to the direction of engine rotation, until the needle on the dial indicator no longer moves.

Set the dial indicator at "0".

Turn the crankshaft in the direction of engine rotation until the TDC marking on the flywheel aligns with the reference marking on the coupling housing.

Check the position of the pump gear using locator mandrel KDEP 1122.

As a rechecking dimension, the dial indicator must show one of the following values.

Pump position 0.65...0.73 mm ABDC (engine D 24)

Pump position 0.78...0.85 mm ABDC (engine D 24 Turbo)







If a correction is required, release the fastening screws for the fuel-injection pump and set the stroke in question by means of pivoting.

Setting values:

Pump position 0.70 mm ABDC (engine D 24)

Pump position 0.80 mm ABDC (engine D 24 Turbo)

Tighten fastening screws to 25 Nm.

Turn the crankshaft twice and recheck the setting.



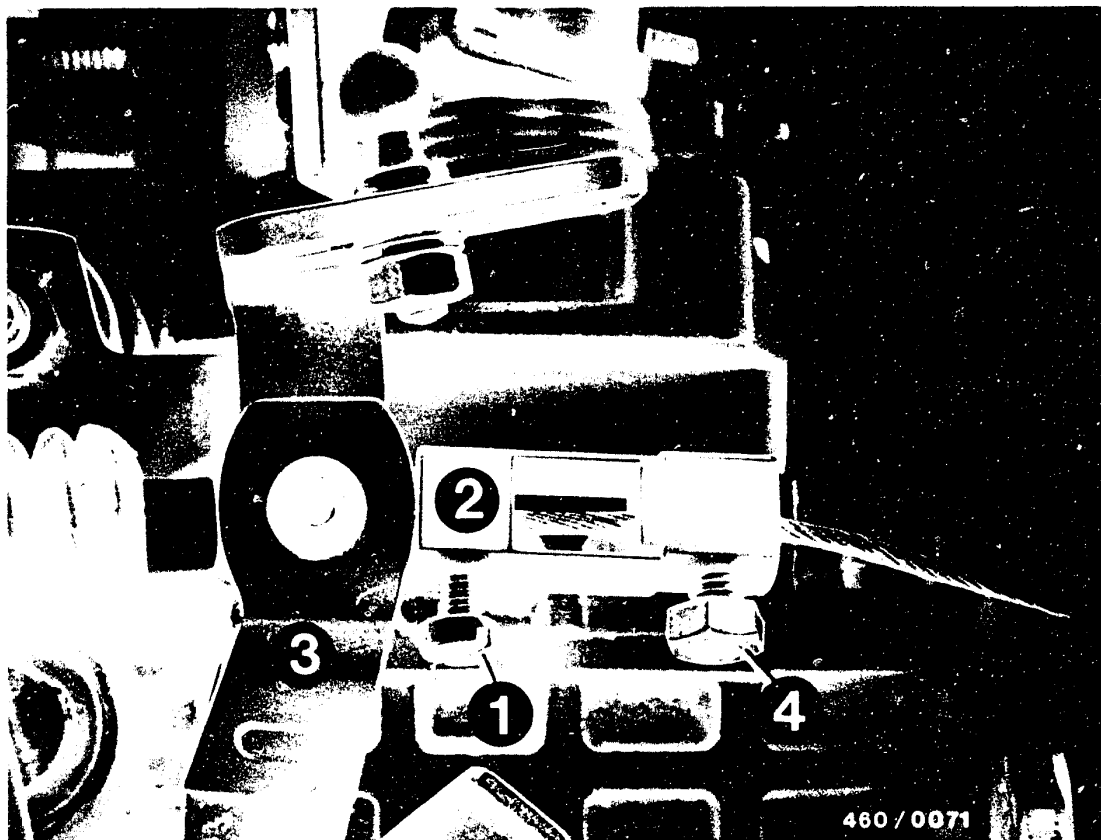
Remove measuring device KDEP 1085 and dial indicator.

Screw in the bleeder screw using a new seal ring.

Put on the toothed-belt cover.

Screw the fuel-injection lines tight to the pressure valve holders of the fuel-injection pump and the nozzle holders (prevent turning of the pressure valve holders by holding them with a wrench).



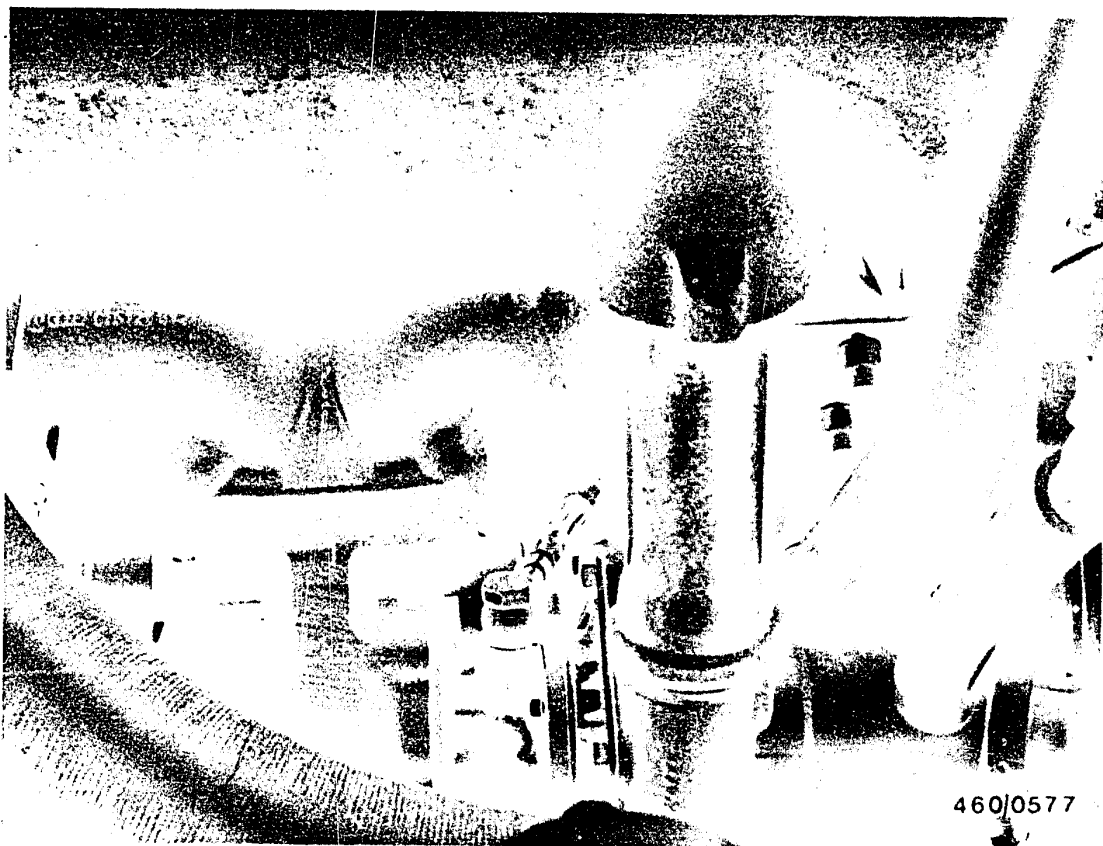


Pull the control lever (3) and the spacer piece (2) toward the hydraulic head.

Turn the spacer piece (2) by  $90^\circ$  and shove it again toward the drive shaft.

The spacer piece is now in its original position (Fig.).

Tighten clamping screw (1).

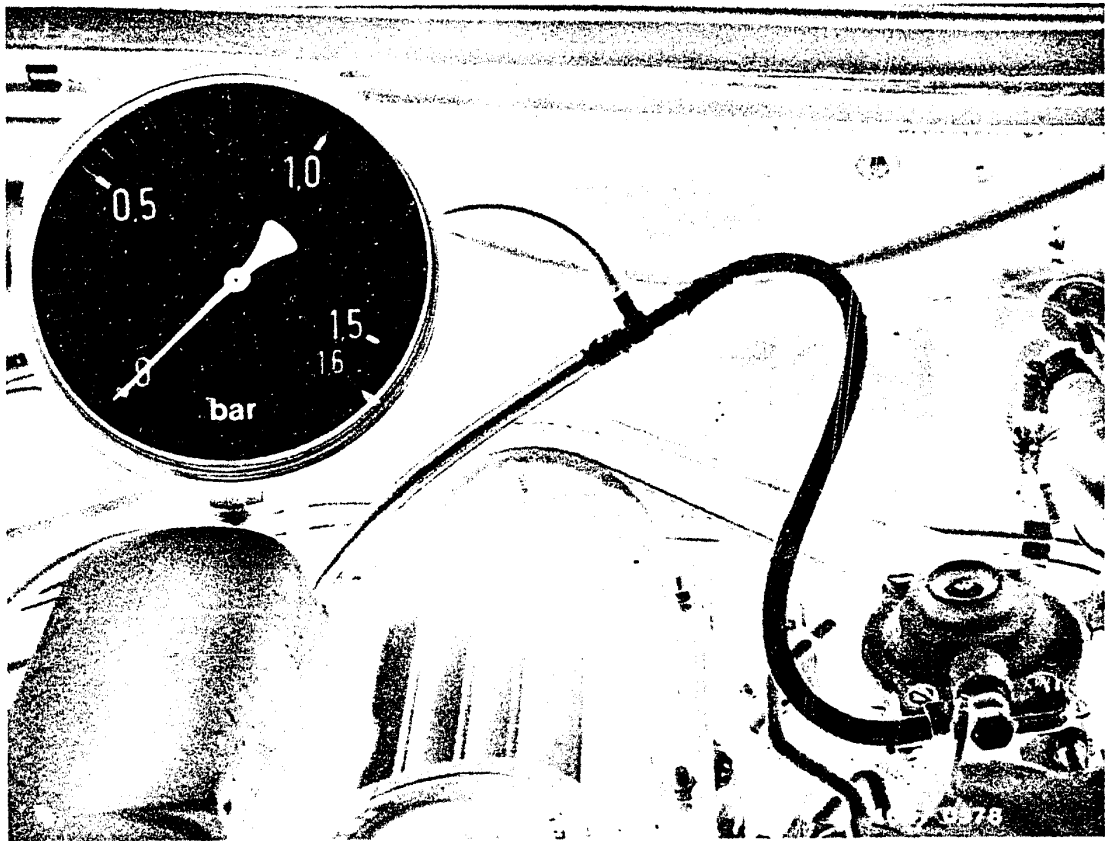


### 31. Checking charge-air pressure

When working on the turbocharger, note that even extremely small particles of dirt can cause destruction of the turbocharger.

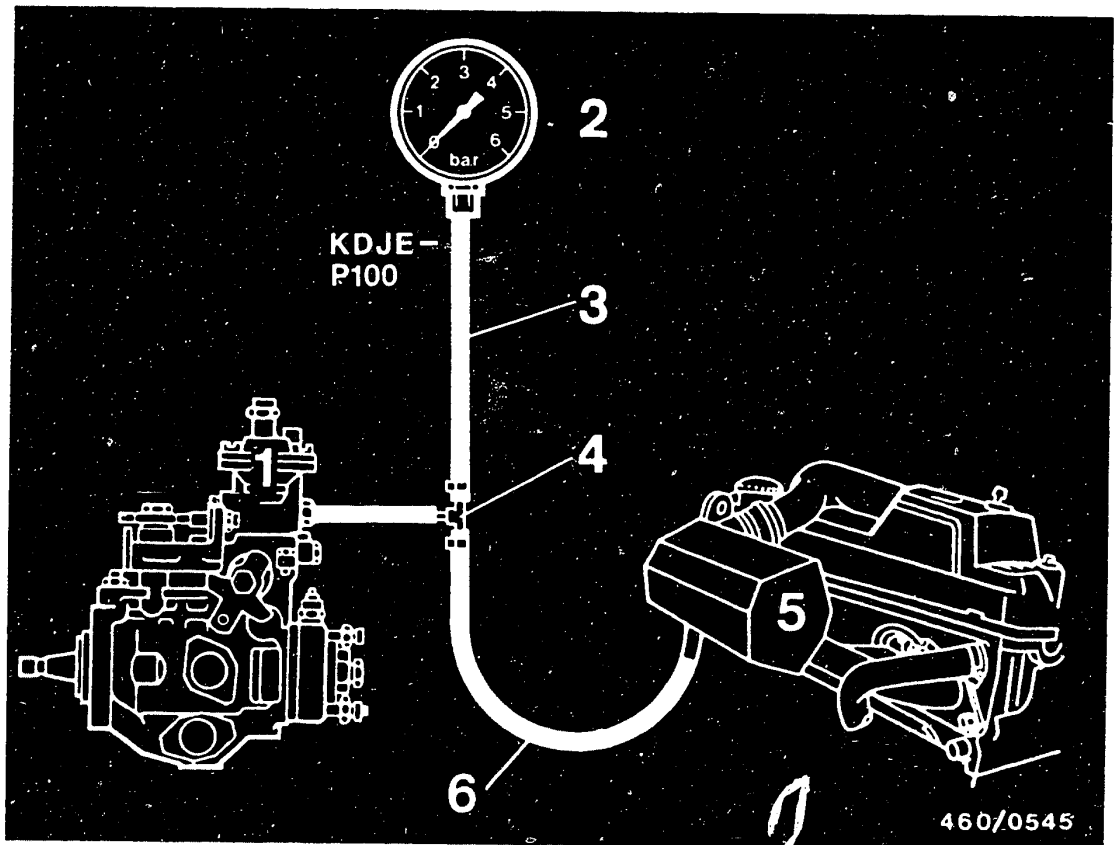
Therefore n e v e r operate the engine without an air filter.





To check the charge-air pressure, pressure measuring device KDJE-P 100, or a pressure gauge 0 ... 1.6 bar (e.g., Wika No. 4184), can be used (Figure).





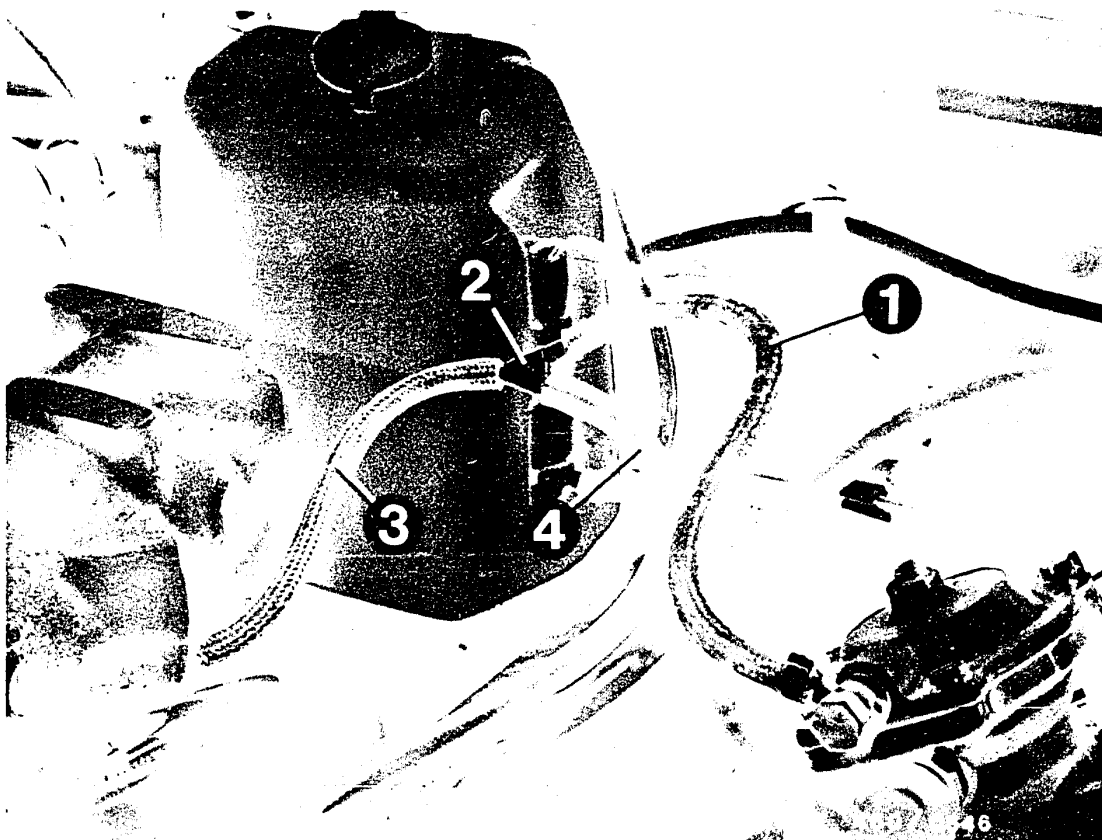
### 31.1 Attachment of pressure measuring device KDJE-P 100

Remove the connecting hose between the charge-air tube (5) and the manifold-pressure compensator of the fuel-injection pump (1) at the charge-air tube.

Put on tee (4).

Using commercially-available hose (6), make connection to the charge-air tube.

Connect the connecting hose (3) for the pressure measuring device (2) to the tee.



### 31.2 Attaching pressure gauge for measurement of charge-air pressure

Remove the connecting hose (1) between the charge-air tube and the manifold-pressure compensator of the fuel-injection pump at the charge-air tube (arrow).

Put on a tee (2).

Using commercially-available hose (3) make connection to the charge-air tube.

Put the connecting hose from the pressure gauge on the tee (4).

### 31.3 Measuring charge-air pressure

The charge-air pressure is measured at full load at 3000 min<sup>-1</sup> on the chassis dynamometer.

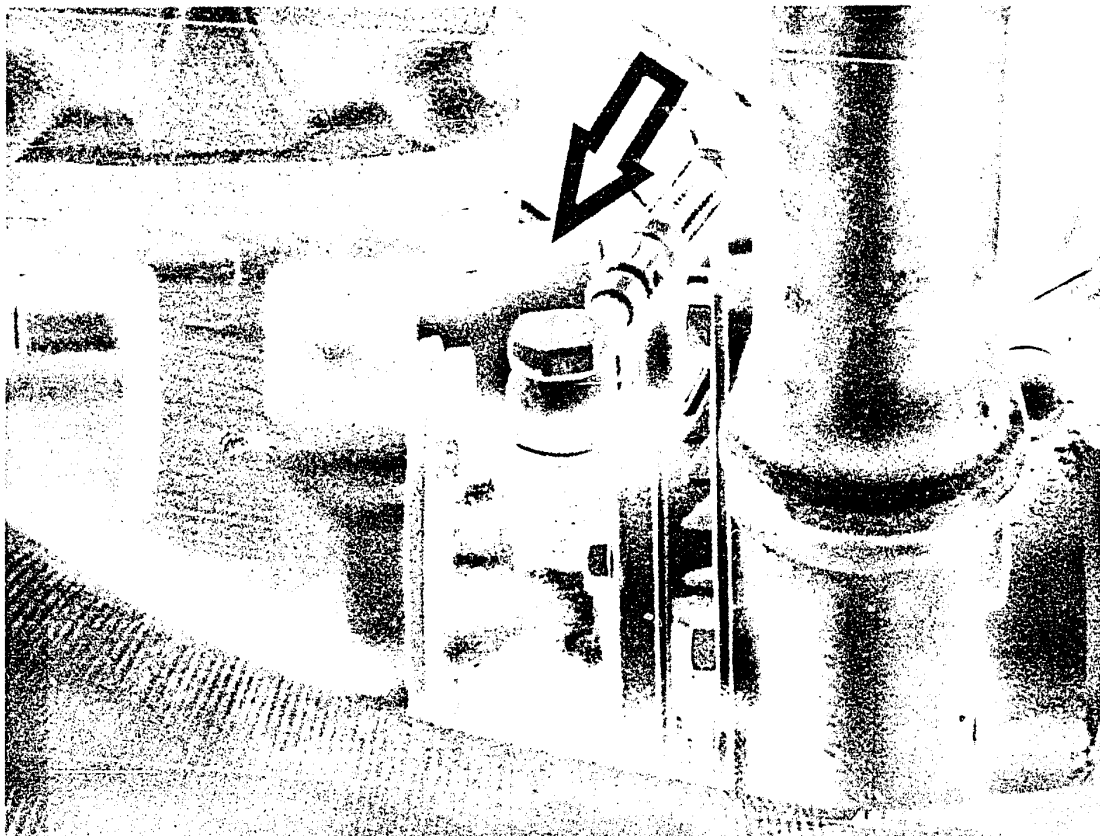
Specified value: 0.70 ... 0.77 bar

#### Note:

In order to evaluate the exhaust turbocharger, it is necessary beforehand that the adjustment of the start of fuel delivery and of nozzle opening pressure is correct, that there are no leaks at the inlet or exhaust ends, and that the mechanical condition of the engine (valve clearance, compression pressure) is in order.







### 31.4 Charge-air pressure too high

- Take out and replace the charge-air pressure control valve (arrow).





### 31.5 Charge-air pressure too low (no leaks)

Remove the connecting hose from the overpressure valve to the charger inlet at the tee (arrow), and seal it with a suitable plug.

Repeat the measurement of charge-air pressure.





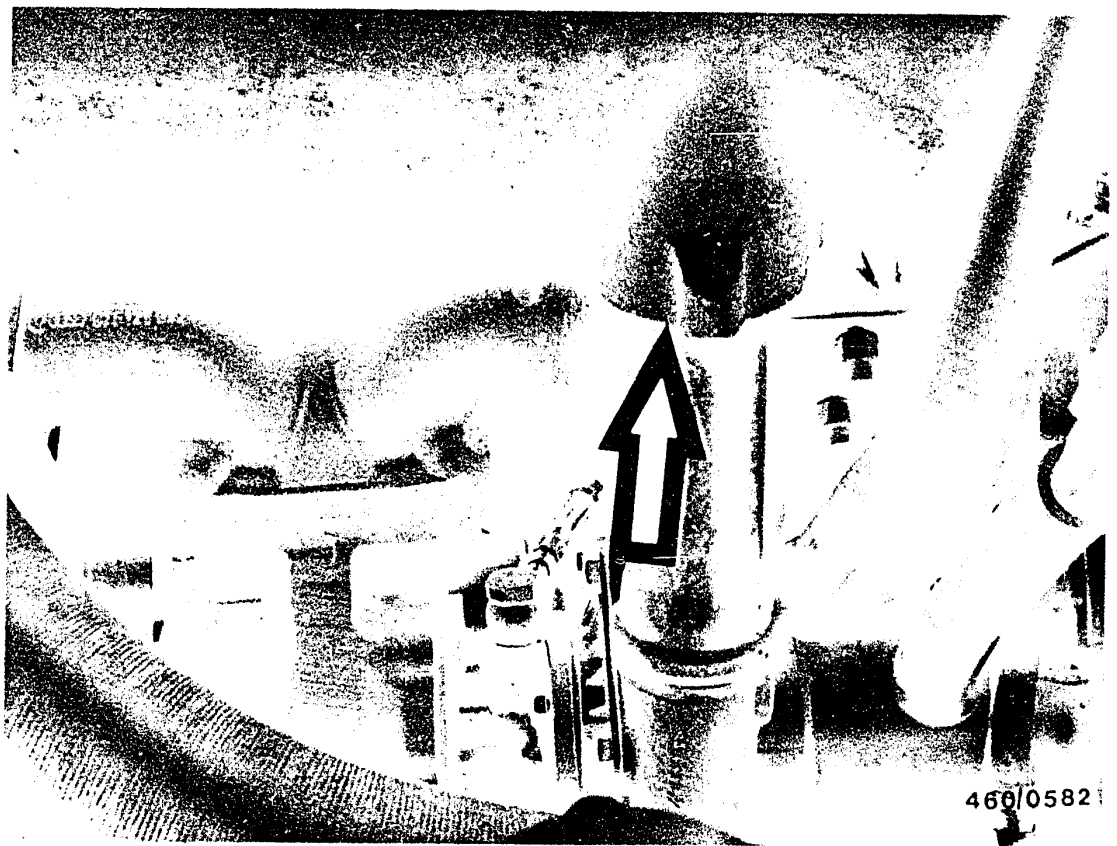
- Charge-air pressure 0.70 ... 0.77 bar  
= Take out and replace overpressure valve (arrow)
- Charge-air pressure still too low  
= As an experiment, take out and replace charge-air pressure control valve.

Then, if the specified value is not reached in a repeated check on the charge-air pressure, take out and replace the exhaust gas turbocharger.

N.B.!

After putting in a new exhaust gas turbocharger, fill the charger with oil and run the engine for approx. 1 min. in order to guarantee the oil supply in the charger.





### 31.6 Checking the exhaust gas turbocharger for leaks

If the charge-air pressure is too low, check the following locations for leaks:

- The seal between the charge-air tube and the engine block.
- The connecting hose between the charge-air tube and the manifold-pressure compensator (fuel-injection pump).
- Diaphragm in the manifold-pressure compensator.
- Connecting tube between the outlet from the compressor and the charge-air tube (arrow).
- Seal between the charge-air pressure control valve and the turbocharger.
- Hose connections at the overpressure valve.



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